

CAN SCIENCE STOP A HURRICANE?

AIR & SPACE

Smithsonian

**F-15C
Eagle
Parting
Shots**

**HOW THE
SPACE
SHUTTLE
DID MORE
WITH LESS**

**WORLD WAR II
HELICOPTER
RESCUE**

***Master of
the Tomcat***

PAGE 32

**FIRST AIRPLANE
IN OUTER SPACE**

JULY 2010

Brazil Expedition Uncovers Thousands of Carats of Exquisite Natural Emeralds

Brandish a whopping 50 carats of genuine South American emeralds in a handcrafted new necklace design for less than \$200... and get a \$100 Stauer Gift Coupon!

Halfway into our ambitious trek through the rain forest I had to remind myself that "Nothing good comes easy." These days it seems that every business trip to Brazil includes a sweltering hike through overgrown jungles, around cascading waterfalls and down steep rock cliffs. But our gem broker insisted it was worth the trouble. To tell you the truth, for the dazzling emeralds he delivered, I'd gladly go back to stomping through jaguar country.

Now our good fortune is your great reward. Don't miss this rare opportunity to own an impressive 50 carat strand of genuine South American emeralds for under \$200. And for a limited time, we'll sweeten every necklace order with a **\$100 Stauer Gift Coupon!**

Faced with this embarrassment of riches, our designer transformed this spectacular cache of large stones (each is over 8 carats average weight) into a stunning 50 ctw necklace of faceted emeralds set into .925 sterling silver. Each emerald is surrounded by delicate sterling silver rope work and filigree in the Bali-style. The 18" necklace dangles from a sterling silver chain that fastens with a secure double-sided shepherd's hook clasp.

What is the source of our emerald's timeless appeal?

The enchanting color of the Stauer **Carnaval Faceted Emerald Necklace** comes from nature's chemistry. Our polished and faceted, well-formed natural emeralds are immediately recognized as something special. Indeed, when we evaluated these emeralds, color was the most important quality factor. Today, scientists tell us that the human eye is more sensitive to the color green than to any other. Perhaps that is why green is so soothing to the eye, and why the color green complements every other color in your wardrobe.

Emeralds are, by weight, the most valuable gemstone in the world.

Now you can wear genuine emeralds and feel great about knowing that you were able to treat yourself to precious gems without paying a precious price. A 100+ carat emerald necklace found on Rodeo Drive or 5th Avenue could cost well over \$250,000...but not from Stauer. Wear and admire the exquisite Stauer **Carnaval Faceted Emerald Necklace** for 30 days. If for any reason you are not dancing the Samba with pure satisfaction after receiving your faceted emerald necklace, simply return it to us for a full refund of the purchase price. But we're confident that when you examine this stunning jewelry, you'll be reminded of the raw beauty of the Amazon rain forests mixed with the flash and dazzle of the exotic Carnaval in Rio de Janeiro. **Call Today. This cache of genuine emeralds is extremely limited.**

A. **Carnaval Necklace** (50 ctw) **\$195** +S&P

B. **Carnaval Ring** (13 ctw) **\$125** +S&P

C. **Carnaval Earrings** (20 ctw) **\$125** +S&P

D. **Carnaval Bracelet** (50 ctw) **\$175** +S&P

Carnaval Collection (83 ctw) ~~\$445~~

Includes necklace, ring and earrings.

Now only **\$295** +S&P **Save \$150!**

***Special Offer—Receive a \$100 Stauer Gift Coupon with the purchase of each individual Carnaval.**

1-888-306-7179

Promotional Code FEN224-02

Please mention this code when you call.



Stauer

14101 Southcross Drive W., Dept. FEN224-02
Burnsville, Minnesota 55337

Smart Luxuries—Surprising Prices



Courtesy NASA, JPL.

Understand the Forces of the Universe

What forces molded the universe? Are those forces still at work? Will Earth one day be gone? Explorations of questions like these seem available to us every day—provided we have a working understanding of the scientific theories on which they're based.

Dr. Neil deGrasse Tyson, the Frederick P. Rose Director of the Hayden Planetarium at the American Museum of Natural History and Visiting Research Scientist and Lecturer at Princeton University, makes that understanding available to anyone. **My Favorite Universe** is a spirited and intellectually engaging journey through the cosmos and its history, from before the big bang to the likely ways in which Earth, and perhaps the entire universe, might end.

Dr. Tyson explains exactly how the formation of the universe came to be, beginning with a grounding in the basic “machinery” of matter, forces, and energy. With this foundation in place, the realities of the universe are revealed in stark and often violent beauty. Explore how black holes are formed and can wreak havoc, how asteroids moving through space represent threats of extraordinary consequence to Earth, and why odds seem overwhelmingly in favor of some kind of life out there.

This course is one of The Great Courses®, a noncredit, recorded college lecture series from The Teaching Company®. Award-winning professors of a wide array of subjects in the sciences and the liberal arts have made more than 300 college-level courses that are available now on our website.

My Favorite Universe

Taught by Professor Neil deGrasse Tyson,
Hayden Planetarium and Princeton University

Lecture Titles

1. On Being Round
2. On Being Rarefied
3. On Being Dense
4. Death by Black Hole
5. Ends of the World
6. Coming Attractions
7. Onward to the Edge
8. In Defense of the Big Bang
9. The Greatest Story Ever Told
10. Forged in the Stars
11. The Search for Planets
12. The Search for Life in the Universe

Order Today!

Offer expires Tuesday, August 3, 2010

My Favorite Universe

Course No. 158

12 lectures (30 minutes/lecture)

DVDs ~~\$199.95~~ **NOW \$39.95**

+ \$5 Shipping, Processing, and Lifetime Satisfaction Guarantee
Special price for shipping, processing, and lifetime satisfaction guarantee for this offer only.

Priority Code: 40285

ACT NOW!

1-800-TEACH-12
www.TEACH12.com/8sas

THE PILOT'S WATCH

The Oyster Perpetual GMT-Master II is the ultimate reference chosen by professionals who fly the world. In 1955, the first GMT-Master was developed together with Pan Am pilots, to ease the adjustment when changing time zones. Today, its successor allows pilots to read three time zones, keeping them punctual in any one. The GMT-Master II is recognized as invaluable to professionals and serious travelers around the world. Visit ROLEX.COM. And explore more.

THE GMT-MASTER II



FOR AN OFFICIAL ROLEX JEWELER CALL 1-800-367-6539.
ROLEX OYSTER PERPETUAL AND GMT-MASTER II ARE TRADEMARKS.
NEW YORK


ROLEX

**"You will rarely find
an emerald necklace with
50 carats and certainly not
at this price!"**

**— JAMES T. FENT, Stauer
GIA Graduate Gemologist**

Special Offer

**Receive a \$100 Stauer
Gift Coupon with the
purchase of this necklace.
Yes, you read
that right.**



A.

50 ctw of
genuine emeralds.
Enlarged to
show details.

Smart Luxuries—Surprising Prices

For fastest service, call toll-free 24 hours a day 1-888-306-7179

AIR & SPACE

Smithsonian

ON THE COVER: The flares released by this Hawaii Air National Guard F-15C may save it from a heat-seeking missile, but not from the multi-role F-22 that will soon take its job. On page 38, Michael Behar writes about the end of the dedicated dogfighter. Photograph by John Dibbs.



Features

20 Titan Air BY TONY REICHHARDT

An airplane that can cruise around Saturn's largest moon will be like nothing that flies on Earth.

LEGENDS OF VIETNAM SIXTH IN A SERIES

24 Truck Killer BY DAVID LANDE

For Douglas A-26A crews, orders were simple: Stop traffic on the Ho Chi Minh Trail.

32 The Real Top Gun BY DEBBIE GARY

Tom Cruise made the F-14 famous, but pilot Dale "Snort" Snodgrass made it a star.

CANCELLED NORTH AMERICAN F-107A

36 Century Series Wannabe

BY STEPHAN WILKINSON

It was fast enough to fly with the best of the interceptors, but it had a monkey on its back.

38 The Last Gunslinger

BY MICHAEL BEHAR

Since the 1970s, the F-15 has dominated in a dogfight. Will the next fighters do the same?

46 Tribute to an Aviation Journalist

Howard Levy's photographs are love letters to airplanes.

52 Climate Control BY SAM KEAN

Nobel Prize winner Irving Langmuir believed he could calm a hurricane, but man was no match for nature.

58 Evolution of the Space Shuttle

BY MICHAEL KLESIOUS

The space shuttle that will soon fly its last mission is a different bird from the one NASA first launched three decades ago.

62 Medevac From Luzon

BY ROGER CONNOR

People hear "helicopter" and think Korea or Vietnam, but helicopters made their combat debut in World War II.



46



24

Departments

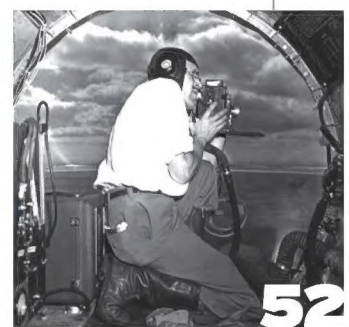
- 4 Viewport
- 6 Letters
- 8 Soundings >>
- 12 Sightings
- 14 In the Museum
- 16 Above & Beyond
- 18 Oldies & Oddities
- 68 Then & Now
- 70 Reviews & Previews
- 74 Credits
- 75 Forecast
- 76 Moments & Milestones



10

On the Web Site www.airspacemag.com

James Cameron created planet Pandora for his 3D film *Avatar*. What's his connection with NASA's plans to explore a real planet? Find the answer and dozens of other Web-only features at www.airspacemag.com.



52



58



It's not the advice you'd expect. Learning a new language seems formidable, as we recall from years of combat with grammar and translations in school. Yet infants begin at birth. They communicate at eighteen months and

speak the language fluently before they go to school. And they never battle translations or grammar explanations along the way. Born into a veritable language jamboree, children figure out language purely from the sounds, objects and interactions around them. Their senses fire up neural circuits that send the stimuli to different language areas in the brain. Meanings fuse to words. Words string into structures. And language erupts.

Three characteristics of the child's language-learning process are crucial for success:

First, and most importantly, a child's natural language-learning ability emerges only in a speech-soaked, immersion environment free of translations and explanations of grammar. Second, a child's language learning is dramatically accelerated by constant feedback from family and friends. Positive correction and persistent reinforcement nurture the child's language and language skills into full communicative expression. Third, children learn through play, whether it's the arm-waving balancing act that announces their first step or the spluttering preamble to their first words. All the conversational chatter skittering through young children's play with parents and playmates — "...what's this..." "...clap, clap your hands..." "...my ball..." — helps children develop language skills that connect them to the world.

Adults possess this same powerful language-learning ability that orchestrated our language success as children.

Sadly, our clashes with vocabulary drills and grammar explanations force us to conclude it's hopeless. We simply don't have "the language-learning gene." At Rosetta Stone, we know otherwise. You can recover your native language-learning ability as an adult by prompting your brain to learn language the way it's wired to learn language: by complete immersion. Our award-winning, computer-based method does just that. Dynamic Immersion® unlocks the innate

What's the fastest way to learn a language? ACT LIKE A BABY.

language-learning ability you acquired before birth and mastered as a child. By recreating the immersion context in which you learned your first language, you understand, speak, read and write your new language

with confidence and accuracy from the beginning — without translations and explanations. At every step and in every skill, you receive instant, actionable feedback, including speech recognition and analysis technologies that prepare you for everyday conversations. And Adaptive Recall® brings back material just when you need it to reinforce and perfect your learning.

Every act of learning is an act of play for children and there's no reason it should be different for learners of any age.

With Rosetta Stone® programs, you rediscover the joy of learning language. Clever, puzzle-like activities produce sudden "Aha!" moments and astonishing language discoveries. Your "language brain" remembers. We see it all the time. A slow smile sneaks across the learner's face after just a few screens. It's a smile of recognition, as though the brain suddenly recalls what it was like to learn language as a child, as though it realizes, "Aha! I've done this before." Act like a baby? You bet. Visit our website and find out how you can reactivate your own innate, language-learning ability with Rosetta Stone. It's the fastest way to learn a language. Guaranteed.*

SAVE 10% TODAY WHEN YOU ORDER Version 3 Personal Edition CD-ROM products.

Level 1	Reg. \$229	\$206
Level 1,2&3	Reg. \$539	\$485
Level 1,2,3,4&5	Reg. \$699	\$629

More than 30 languages available.



WIN/MAC compatible.

SIX-MONTH, NO-RISK, MONEY-BACK GUARANTEE.*

PICK UP A NEW LANGUAGE TODAY.

(866) 290-6601 RosettaStone.com/ais060

Use promo code ais060 when ordering.

RosettaStone® 

Editor	Linda Musser Shiner
Art Director	Ted Lopez
Executive Editor	Paul Hoversten
Senior Editors	Tony Reichhardt Patricia Trenner
Senior Associate Editor	Perry Turner
Associate Editors	Michael Klesius Rebecca Maksel Diane Tedeschi
Photography and Illustrations Editor	Caroline Sheen
Researcher	Roger A. Mola
Founding Editor	George C. Larson

CONTRIBUTING EDITORS

Roger Bilstein	Eric Long
William E. Burrows	Stephen Maran
Eric Chaisson	Laurence Marschall
Tom Crouch	Ted Maxwell
David DeVorkin	Marshall Michel
Freeman Dyson	Ron Miller
Daniel Ford	Brian Nicklas
Greg Freiherr	James Oberg
Donald Goldsmith	Dominick Pisano
George Greenstein	Robert E. Pollack
William Gregory	George Robinson
Dan Hagedorn	Chad Slattery
R. Cargill Hall	Marcia Smith
Richard Hallion	Robert W. Smith
Jim Hansen	Jill Tarter
Gregg Herken	G.L. Verschuur
Nick Komons	Stephan Wilkinson
W. David Lewis	

EDITORIAL: (202) 633-6070

e-mail: editors@si.edu

Web site: www.airspacemag.com

Air & Space/Smithsonian, June/July 2010; Vol. 25, No. 2

Air & Space/Smithsonian published an extra issue in September 2009. Subscribers will still receive 6 or 12 issues as part of their paid subscriptions; however, membership expiration dates may move. *Air & Space/Smithsonian* (ISSN 0886-2257) is published bimonthly by Smithsonian Enterprises, MRC 513, PO Box 37012, Washington, DC 20013-7012. Periodical postage paid at Washington, DC, and additional mailing offices.

POSTMASTER: Send change of address to *AIR & SPACE/Smithsonian*, PO Box 420113, Palm Coast, FL 32142-0113. Printed in the USA. Canadian publication agreement no. 40039324. Canadian return address: Brokers Worldwide, PO Box 1051, Fort Erie, ON L2A 6C7 Canada.

We may occasionally publish extra issues. ©Smithsonian Institution 2010. All rights reserved. Reproduction in whole or in part without permission is prohibited. Editorial offices: MRC 513, PO Box 37012, Washington, DC 20013. Circulation and advertising offices: 420 Lexington Ave., New York, NY 10170.

Subscriptions: U.S. and possessions: \$26 a year payable in U.S. funds. Canada and all other countries: add \$6.00 (U.S. funds) per year. Ninety-nine percent of dues is designated for magazine subscription. For address changes and subscription orders: mail to *AIR & SPACE/Smithsonian*, PO Box 420113, Palm Coast, FL 32142-0113; call (800) 513-3081; outside the U.S., call (386) 447-2721.

Mailing Lists: We sometimes make our subscriber list available to companies that sell goods and services that we believe would interest our readers. If you do not want to receive such mailings, send your current mailing label or, an exact copy, to: *AIR & SPACE/Smithsonian*, Mail Preference Service, PO Box 420113, Palm Coast, FL 32142-0113.

Single copies: To purchase an issue (current \$4.99, back issue \$7), please write *AIR & SPACE/Smithsonian*, 420 Lexington Ave., Suite 2335, New York, NY 10170, or call (212) 916-1300.

Building a Wall of Support

ONE OF MY CHIEF PLEASURES in the 10 years I've been director of the National Air and Space Museum has been watching the progress of the Museum's Wall of Honor. Constructed along the walkway leading to the Steven F. Udvar-Hazy Center in northern Virginia, the wall had more than 8,000 names when we opened the Center in December 2003. We have now inscribed the names of almost 20,000 individuals and associations, and the list continues to grow.

Whose names are on the wall? Some of the first names inscribed belong to the giants of aviation and space exploration: Wilbur and Orville Wright, Jimmy Doolittle, John Glenn, Neil Armstrong, Jim Lovell, and others. In that fine company are the names of people with a passion for flight, and their donations, or the donations made on their behalf, helped us build the Udvar-Hazy Center and are continuing to help with our plans there. Some are pilots who themselves are part of aviation history. Others are aviation or space enthusiasts who merely wish to support the preservation of aerospace history. On page 14 of this issue, you'll find the stories behind three of the donors who added names to the wall.

As the names have multiplied, the wall's setting has grown more beautiful. The trees and landscaping have matured. The wall is composed of stainless steel airfoils that weigh 750 pounds each, so when we say it is a permanent monument, we mean permanent. And we treat it with the respect memorials deserve: We tend

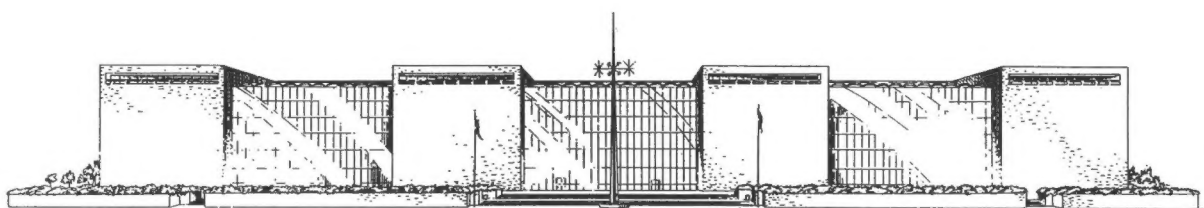
the plants and remove snow from the airfoils. (The latter was a real challenge during the past winter, when we got more than three feet of snow.)

Perhaps the most significant of the wall's features is its place of honor near the nation's most prominent air and space museum. All who visit the Udvar-Hazy Center to learn about the history of aviation and space exploration walk by the names of those who helped create that history and in whose names it is being preserved.

Donations now being made to engrave names on the Wall of Honor are helping us complete Phase Two of the Udvar-Hazy Center, which will include the Mary Baker Engen Restoration Hangar; an Archive Unit for print, photographic, and film documentation; and a Collections Storage Facility with state-of-the-art environmental controls to preserve our treasures.

If you read this column regularly, you know that my father was a U.S. Marine Corps aviator who flew the F4U Corsair in World War II and who inspired my own career in Marine aviation. Several years ago, I put my dad's name on the wall. I did it for the same reason everybody else has for placing a name on the Wall of Honor. I wanted to create a permanent memorial for somebody important to me. And I feel great satisfaction every time I walk by and see my dad's name surrounded by the names of others who loved flying.

■ ■ ■ J.R. DAILEY IS THE DIRECTOR OF THE NATIONAL AIR AND SPACE MUSEUM.



"As the master craftsman who opened the famous Lincoln Pocket Watch in Washington, D.C., I recently reviewed the Stauer Meisterzeit timepiece. The assembly and the precision of the mechanical movement are the best in its class."

—George Thomas
Towson Watch Company



We Can Only Find One

A rare chance to claim a unique piece of watchmaking history for under \$100!

Eighty-six years ago, a watchmaker in Paris famous for building the magnificent clocks at Versailles created a legendary timepiece. He invented the first watch with an automatic mechanical drive. These innovative movements required no batteries and never needed to be manually wound. Only seven of these ultra-rare watches were ever made and we've studied the one surviving masterpiece in a watch history museum. Inspired by history, classic design and technology, our Stauer *Meisterzeit II* has been painstakingly handcrafted to meet the demanding standards of vintage watch collectors.

Why the new "antique" is better than the original. The original timepiece was truly innovative, but, as we studied it closely, we realized that we could engineer ours with a much higher level of precision. The 27-ruby-jewel movement utilizes an automatic self-winding mechanism inspired by a patent from 1923, but built on \$31 million in state-of-the-art Swiss-made machinery. With an exhibition back, you can see into the heart of the engineering and view the rotor spin—it's powered by the movement of your body.

This limited edition Stauer *Meisterzeit II* allows you to wear a watch far more exclusive than most new "upscale" models. Here is your chance to claim a piece of watchmaking history in a rare design that is priced to wear everyday.

Elegant and accurate. This refined beauty has a fastidious side. Each movement and engine-turned rotor is tested for 15 days and then certified before it leaves the factory.

The best part is that with our special price, you can wear a superb classic historical reproduction watch and laugh all the way to the bank. Stauer specializes in classic timeless watches and jewelry that are made for the millionaires who want to keep their millions. This watch will quickly move to heirloom status in your household.



View the precision movement of the *Meisterzeit* through the rear exhibition port.

Try it for 30 days and if you are not thrilled with the beauty and construction of the *Meisterzeit II*, simply return it for a refund of the purchase price.

Only 4,999 available. Since it takes about 6 months to build each watch, the release is a limited edition, so please be sure to order yours soon.

WATCH SPECS:

- 18K Gold-clad case and bezel
- Precision 27-jeweled movement
- Interior dials display day and month
- Croc-embossed leather strap
- Fits 6 3/4"-8 1/4" wrist

80% OFF

Exclusively Through Stauer

Stauer Meisterzeit II Watch—~~\$395~~
Now only \$95 +S&P Save \$300!

Call now to take advantage of this limited offer.

1-888-324-4351

Promotional Code MZW263-01
Please mention this code when you call.

Stauer

14101 Southcross Drive W.,
Dept. MZW263-01
Burnsville, Minnesota 55337
www.stauer.com

Smart Luxuries—Surprising Prices

Letters

WRITE TO US

Bob Hoover to the Rescue

I believe Bob Hoover saved my life and that of my flying student ("Simply the Best," Apr./May 2010).

Flying one day in the landing pattern as an Air Force T-38 instructor, I made the terrible mistake of allowing my student to land from an angling final approach. When he then mishandled the crosswind and allowed the jet to weathervane, our speed, about 160 to 175 mph, resulted in the T-38 darting for the grass lickety-split.

Almost immediately, I took control of the jet.

Though it had been a few years since I last saw Bob Hoover do his one-wheel landing in the P-51, that maneuver was the only thing I could think of in the split-second I had to try to save us. I

could tell from the rear cockpit, my seat was tracking the runway edge, with the right gear barely on the pavement. Precarious as our situation was, there was good news. From the combination of right bank and having the otherwise-wrong, upwind wing high into the crosswind, the jet was turning back to the pavement.

Thanks, Mr. Hoover. I'll always believe it was you who saved us that day.

Wally Soplat
via e-mail

As co-author of *Spitfires and Yellow Tail Mustangs*, the history of the 52nd Fighter Group, I had hoped the Bob Hoover story would say more about his wartime career in that unit [see photo below]. It is not well known that U.S.

forces operated the British Spitfires for at least two years, mainly in the 52nd and 31st fighter groups, and operated Spitfire XIs in the 7th Photo Group for a longer period.

Paul A. Ludwig
Seattle, Washington



BOB KLUG

Bob Hoover on Corsica in January 1944, awaiting a scramble in a Spitfire.

also knew that if the maneuver didn't work, I had just a few more heartbeats until I'd be forced to verbally direct a dual ejection. And even an ejection didn't seem a sure thing.

Quickly, I put in as much right aileron as I could stand to roll the jet up on its right main gear. Since T-38s are always landed in a crab with crosswinds, and the wing-low landing technique is not permitted, I had no idea how the jet would behave on one wheel, or if it would even go there.

To my relief, the T-38 rolled up nicely on the right gear into about 20 to 30 degrees of bank. I could only see grass to the left side of the plane. As best as I

The writer of "Osprey at War" (Apr./May 2010) describes putting his backpacks on his lap, rather than under the seat. The reason is that the room under the MV-22's seats is taken up with shock absorbers. Unlike many earlier military rotorcraft, the Osprey has crashworthy seats for the passengers.

J.R. Dailey, Director
National Air and Space Museum
Washington, D.C.

Flying Back in Time

"The Pride of Cherry Grove" (Apr./May 2010) says at least one unofficial variant of the Pietenpol was built as a biplane. There could be more, but I am aware of just one. I owned it for a few years.

AIR & SPACE

Smithsonian



Smithsonian Institution

MEDIA GROUP

Director, Smithsonian Media	Thomas Ott
Executive Asst. to the President	James A. Babcock
General Manager	Alan Chu
Group Publisher	Kerry Bianchi
Assoc. Publisher, Marketing & Sales Development	Rosie Walker
ADVERTISING	(212) 916-1300
Ad. Services Manager New York	Marilyn Cruz James F. Else, Regional Sales Dir., Meryle Lowenthal, Lori D. Scelzi, Elise I. Boeger
Midwest Detroit	Bill Milligan
Southwest	Colleen Maiorana
Southeast	Steve Moynihan
West Coast	Kelly Hediger
Caribbean/Cent. Amer.	Kate Knox, Charles Carroll
Mexico	Al Nadal
Canada	Elsie Mendez Enriquez Richard Brown, Cindy Ratych, David Seaberg, Greg M. Smith
Japan	Yoshinori Ikeda, Shigenori Nagatomo
Thailand	Yvan Van Outrive, Ja Pipatra
Korea	S.S. Song
Direct Response	MI Media Services, LLC
Interactive Ad Operations Coordinator	Joel Newman

MARKETING/RESEARCH

Associate Art Director	Natalie Thompson
Associate Marketing Director	Laurie A. Corson
Marketing Manager	Caitlin McCarthy
Promotions Coordinator	Elizbaeth Stoll
Research Manager	Marilyn Resciniti

CONSUMER MARKETING

Consumer Marketing Director	Lisa Dunham
Planning Director	Mary Ramsey
Fulfillment Director	Andrea Sole
Renewals & Gift Dir.	Susan Warner
Purchasing & Operations Manager	Grace Riker
New Business Director	Lori Paldino
Gift Manager	Jonathan Balangon
Associate New Business Manager	Laura E. Vichick
Renewals Marketing Coordinator	Piper Miles-Coccaro

ONLINE PUBLISHING GROUP

Director, Internet Business Operations and Strategy	Michelle McMahon
Manager, Online Marketing and Analysis	Jennifer L. Bock
Sr. Web Designer	Bilikya Schiller
Web Developers	Damie B. Malone, Tony Rosenberger
Sr. Web Producer	Kelly Durkin
Producer	Cheryl Carlin

MANUFACTURING

Director	Sarah D. Kingsley
Prepress Director	Katherine Balch
Prepress Manager	Frank Matthew Hale II
Prepress Manager	Marie Koller
Color and Quality Mgr.	Stanley Boone
Adv. Systems Manager	Penie Atherton-Hunt

BUSINESS OFFICE

Business Manager	Ed Dequina
Accountant	Joanne Hubbard

SMITHSONIAN ENTERPRISES

President	Thomas Ott
------------------	------------

Secretary

G. Wayne Clough

Director, National Air and Space Museum

General John R. Dailey, USMC (ret.)

SMITHSONIAN BOARD OF REGENTS

Chancellor

John Roberts, Chief Justice of the United States

Chair

Patricia Q. Stonesifer

Vice Chair

Alan G. Spoon

Members

Joseph R. Biden, Jr.

Vice President of the United States

Appointed by the President of the Senate

Hon. Thad Cochran

Hon. Christopher J. Dodd

Hon. Patrick J. Leahy

Appointed by the Speaker of the House

Hon. Xavier Becerra

Hon. Sam Johnson

Hon. Doris Matsui

Appointed by Joint Resolution of Congress

Dr. France Córdova

Dr. Phillip Frost

Dr. Shirley Ann Jackson

Mr. Robert P. Kogod

Mr. John W. McCarter Jr.

Mr. David M. Rubinstein

Mr. Roger W. Sant

SMITHSONIAN NATIONAL BOARD

Chair Mr. Paul Neely

Vice Chairs Mrs. Peggy Paulson Burnet, Ms. Judy S. Huret,

Mr. Gary B. Moore

National Board

Mr. Rodney C. Adkins, Mr. Gordon M. Ambach,

Ms. Valerie Anders, Mrs. Judy Hart Angelo,

Hon. Barbara McConnell Barrett, Mr. William H. Bohnett,

Ms. Jane Lipton Cafritz, Mr. Thomas H. Castro,

Mr. Wilmer S. Cody, Ms. Abby Joseph Cohen,

Mr. James F. Dicke II, Mr. John G.B. Ellison Jr.,

Ms. Sakurako D. Fisher, Mr. Michael R. Francis,

Mr. John French III, Mrs. Shelby M. Gans, Mr. E.K. Gaylord II,

Ms. Myra M. Hart, Mr. Richard W. Herbst,

Mr. Robert F. Higgins, Mr. Steven G. Hoch,

Mrs. Anne B. Keiser (*ex-officio*), Mr. Jonathan M. Kemper,

Mrs. Betsy Lawer, Mr. Robert E. Long Jr.,

Mr. Robert D. MacDonald, Mrs. Dorothy S. McAuliffe,

Mr. Chris E. McNeil Jr., Mr. Russell E. Palmer Jr.,

Mr. William M. Ragland Jr., Mrs. Kristin Richardson,

Hon. Ronald A. Rosenfeld, Mrs. Theiline P. Scheumann,

Mrs. Marna Schnabel, Mrs. Phyllis M. Taylor,

Mr. Douglas C. Walker

Honorary Members

Mr. Robert McC. Adams, Mr. William S. Anderson,

Hon. Max N. Berry, Mr. L. Hardwick Caldwell III,

Mr. Frank A. Daniels Jr., Mr. Charles D. Dickey Jr.,

Mrs. Patricia Frost, Mr. I. Michael Heyman,

Mr. James M. Kemper Jr., Mrs. Jean B. Mahoney,

Justice Sandra D. O'Connor (ret.), Mr. Francis C. Rooney Jr.,

Mr. Wilbur L. Ross Jr., Mr. Lloyd G. Schermer,

Hon. Frank A. Weil, Mrs. Gay F. Wray

Letters

Though I did not build it, my biplane was built to somewhat resemble a Great War British SE5a. It had three non-working replica machine guns: a pair of Vickers on the cowl and a Lewis Gun on the upper wing. I often dressed as a World War I pilot and flew it to nearby airshows [see photo at right].

Like the parasol-wing Pietenpols, my biplane was easy to fly and very forgiving.

Captain Monty Mendenhall
United Air Lines (ret.)
via email

One Letter Makes a Difference

“Deadstick Landings” (Dec. 2009/Jan. 2010) brought to mind an experience from my days as an Army Air Forces pilot in World War II. I was scheduled for my six-month check flight: flying a new C-54E from Miami to Washington, D.C. We had a very light load—about 20 GIs. We filled only the main tanks; for this short trip we didn’t need to worry about the auxiliary tanks. Since neither I nor the check pilot had flown the C-54E before (we had both been flying the D model), we cornered a friend who had flown the E and asked him if there was anything we needed to know about it. He assured us that there was no significant difference.

We took off, and just after we passed West Palm Beach, an engine quit. In a lightly loaded C-54, that was no problem. Still, seeing that this was a check flight, I followed the book, turning around and heading back to West Palm. But then a second engine quit. And then the other two.

Fortunately we were then within gliding distance to the West Palm



COURTESY MONTY MENDENHALL

The letter writer and his Piet variant, both dressed for World War I air combat.

airfield, so we radioed in and the emergency services rolled out. We made a good landing. Our engineer then stood up and said: “My God, we were flying on the auxiliary tanks!” Turns out there was one difference between the D and the E: The fuel tank switches were reversed.

Ray C. Frodey
Fremont, Michigan

Corrections

Apr./May 2010 “2010 Airshow Gawker’s Guide”: (1) The picture on page 21 shows Neill Herman, not Hugh Schoelzel. (2) The Harrier has one engine, not two (p. 25).

“Grab the Airplane and Go”: The photograph on p. 39 shows a Challenger 601, not a Citation. The error was introduced during editing.

“Honoring Vanley Johnson,” Soundings: The airfield in Wendover, Utah, is not closed. It is presently operated as a civilian facility.

Feb./Mar. 2010 “Bell Bails from the Bubble,” Soundings: The Bell Model 47 was not the first helicopter Arthur Young designed; the Model 30 was.

WRITE TO US at Letters, *Air & Space/Smithsonian*, MRC 513, P.O. Box 37012, Washington, DC 20013. Please type or print clearly. You must include your full address and daytime phone number.

e-mail: editors@si.edu. All e-mails must include your full name, mailing address, and daytime phone number.

Air & Space is not responsible for the return of unsolicited materials. Never send unsolicited original photographs to the Letters department; send only copies.

All letters selected for publication are edited. We reserve the right to publish letters in the magazine, on our Web site (www.airspacemag.com), or both. We regret that we cannot respond to every letter.

Soundings

NEW IDEAS, ODDBALL EFFORTS, STRIDES AND MISSTEPS

The Festival of Gagarin

EVERY APRIL, the people of Earth host Yuri's Night, a planet-wide party in honor of cosmonaut Yuri Gagarin's historic spaceflight in 1961. This year 222 parties in 67 countries joined in, and NASA's Ames Research Center in Mountain View, California, threw one of the biggest celebrations, welcoming some 11,000 visitors for a two-day festival that mixed music and science with art and sci-fi regalia. "We want to associate science and space



with fun and inspiration," said center director Pete Worden, who would later



Visitors at the Ames Center's "Yuri's Night" were dazzled by DJ group The Glitch Mob. Left: Costumed Ames director Pete Worden and NASA deputy administrator Lori Garver presided while a youthful Gagarin looked on from photographs (right).

greet the crowd dressed as a Klingon. Worden's message was not lost on the dance floor, where humanoids, sentient machines, and extraterrestrials exuberantly shook their assorted appendages. "The community at this event essentially represents all the elements of creativity rolled into one—performance, music, costuming, technology," said a fellow identifying himself simply as Pope, who wore a homemade spacesuit and incorporated the use of astronaut-style grabber hands into his dance routine. "They dovetail very nicely."

In the courtyard, where revelers watched musical

climbed into an enormous retro-style rocket, a tutu-clad Libby Woods was taking a break from dancing with a hula hoop. She found Yuri's Night "beautiful," and said, "I like that we're merging the space world with the psychedelic dance world, because I feel in a lot of ways they go hand in hand."

Science buffs Linda Pham and Philip Faulconer, outfitted as robots activated by "fun switches," were enjoying their first NASA visit. "I was pretty excited just to walk through the hangar and look around," said Faulconer. Inside the hangar, booths offered information about algae, hydroponics, synthesizers, asteroids, and, of course, Yuri, while lecturers had their own stage: Morrison Planetarium director Ryan Wyatt presented a tour of the universe, and NASA planetary scientist Chris McKay fielded questions about the search for life on

UPDATE

Robert M. White 1924 - 2010

FORMER WORLD WAR II POW, Korean War veteran, and Air Force test pilot Bob White died on March 17. "The old Irishman went home at 11:55 last night," his son, Greg, wrote in an e-mail to friends and relatives. Major General White retired from the Air Force in 1981 with a wealth of medals, decorations, trophies, and commendations. "Seeing his story in print," says Al Hallonquist, who helped him write "An Extra Two Seconds" (Above & Beyond, April/May 2010), "meant so much to him." In July 1962, White flew an X-15 to 314,750 feet, becoming the first person to fly an aircraft above 300,000 feet and also the first to fly a winged vehicle into space, for which he earned astronaut wings – the first such wings awarded to an aircraft pilot. White was named commander of the Air Force Flight Test Center at Edwards Air Force Base in California in 1970.



Bob White, who died in March, made 16 flights in the world's most accomplished X-plane.

Mars. Initially aimed at young professionals, the event has been expanded to include younger students, who are, in Worden's phrase, "the kids that are going to take us to the stars." This year's Yuri's Night was preceded by an Education Day; Ames invited 4th through 12th graders for crafts, games, and inspirational speakers. SETI Institute scientist Jeffrey Van Cleve urged students to pursue science careers, Apple co-founder Steve Wozniak spoke about how the space race revolutionized computing, and turntablist DJ Qbert provided a lesson in the science of scratching. "Music is all math," said Qbert, mixing a set that melded Chic's "Good Times" with an explanation of how a record player works. "When you bring science and spirituality together, you get creativeness."

KARA PLATONI

Wiltrotor

WHEN THE EPITAPH is written for the Bell-Agusta BA609 civil tiltrotor, it may be: Right aircraft, wrong market. Originally envisioned as a six-passenger executive transport that would land and take off like a helicopter but cruise like a turboprop at altitudes up to 25,000 feet with a maximum forward speed of 356 mph, the vertical-takeoff-and-landing aircraft was a hit when first announced in 1996. The order book for the aircraft quickly built to 80 units. However, as the years passed, orders stagnated, and even shrank a bit. Meanwhile, development partners Bell and AgustaWestland devoted their resources to more promising commercial and military helicopter programs.

The schedule for the 609 slipped at least a year every year, and as it did the estimated per-unit price of the product rose: What started as \$8 million to \$10 million became \$29 million with direct operating costs of an estimated \$8,000 to \$10,000 per hour—two to three times the rate of a 500-mph midsize transcontinental corporate jet and well out of the price range of most commercial operators. Yet even before production lag and price escalation, the suitability of the 609 for civil missions fell into question: People worried about the impact a 16,800-pound aircraft would have on existing helipads.

Three years ago, AgustaWestland, in tacit acknowledgment that the aircraft had been aimed at the wrong market, began touting the 609 as an ideal coastal patrol and search-and-rescue vehicle. Amid talk of a large order from the Italian government, the company began agitating for a majority stake or even to buy out Bell's share entirely. Negotiations are now under way to accomplish one or the other. AgustaWestland's optimistic CEO, Giuseppe Orsi, wants the deal completed by June.

MARK HUBER



Two civilian tiltrotors are flying : N609TR (above) was born and raised in Texas; sister ship N609AG calls Italy home. Bell may soon give up parental rights.



Flights of the unmanned X-48B tested angle-of-attack and sideslip limiters, which prevent stalls at low speeds.

UPDATE

It Flies, But It Still Looks Weird

NASA AND BOEING report that the X-48B hybrid wing-body has completed Phase 1 flight tests at the Dryden Flight Research Center in Edwards, California ("Batplane," Sept. 2009). The remotely piloted 1/12-scale model made its 80th flight on March 19, some three years after its first flight. With Phase 1, "the team has proven the ability to fly tailless aircraft to the edge of the low-speed envelope safely," says Fay Collier, a manager in NASA's Aeronautics Research Mission Directorate. Installation of a new flight computer will enable further testing later this summer. A second X-48B that has not flown will be converted to an X-48C that will minimize fuel consumption in cruise.

Running Low on Adventures

WHEN THE SPACE SHUTTLE retires this year, the only way to reach the International Space Station will be aboard Russian Soyuz capsules—good news for the Russians, but not so good for space tourists.

Space Adventures, a pioneer in private spaceflight, relies on Soyuz for its high-flying customers. Now there's serious competition for those Soyuz seats, as NASA begins snapping them up at \$51 million each—\$16 million more than Space Adventures customer



Charles Simonyi paid last year.

"The price continues to just go up and up and up," laments Space Adventures CEO Eric Anderson. He

"No Space Tourists" – Soyuz flights to the International Space Station have been snapped up by NASA.

can only hope that the Soyuz gets some healthy competition. It may come from Space Exploration Technologies, also known as SpaceX, now under contract with NASA to supply the space station with cargo. The company has said that its Dragon capsule, which is designed with windows, can also carry passengers.

Meantime, Space Adventures has arranged for a Soyuz mission all to itself. Besides the pilot, there's room for only two passengers, but the arrangement sets a precedent for more. "The Russians have indicated that they will be capable of building more Soyuzes so that we are able to continue flying private citizens even beyond what NASA buys," says Anderson.

The first Soyuz dedicated to private space travel won't be ready for at least another three years, but Anderson says he isn't worried: "We had a break between 2002 and 2005." That period was the last time NASA had to use Soyuz as a space taxi. "I'm very optimistic. But we have to be patient."

His company plans to build up its existing zero-gravity business, and is also planning the ultimate space adventure: a lunar flyby mission, again with the Russians as partners.

■ ■ ■ MICHAEL BELFIORE

WORK IN PROGRESS



Downsize = Upgrade

LAST FEBRUARY, NASA began an upgrade of its Deep Space Network antennas, starting with the dishes in Canberra, Australia. All of the network's 230-foot-wide antennas (center, in photo above) will be replaced with dishes half that width that will carry several frequency bandwidths, including higher-frequency, wider-bandwidth signals of the "Ka band," which is required for all missions approved after 2009. The smaller dishes are "beam wave guide" antennas that will enable the network to operate on several different frequency bands within the same antenna. The agency plans to complete three new antennas in Canberra by 2018; work at the Goldstone, California and Madrid, Spain complexes will likely run through 2025. The Deep Space Network is managed by NASA's Jet Propulsion Laboratory in California.

In Canberra, Australia, antennas of the Deep Space Network support interplanetary missions.

NASA's Great Gear Giveaway

"OUR OBJECTIVE is to get rid of stuff we don't need," says Susan Kenney, director of logistics at NASA's Washington, D.C. headquarters. NASA's warehouses are stuffed with superfluous items, and the agency needs to make room for future programs. For the first time, they're giving it away. All you have to do is pay shipping and handling. But the average citizen probably isn't qualified to receive any of it. At least not a space shuttle orbiter. Or that Apollo

HEADS UP

Legends of Flight

FILMED IN 3-D FOR IMAX

Premieres June 11 in Washington, DC, Chicago, IL, Hutchinson, KS, Jersey City, NJ, Garden City, NY, Dayton, OH, Chantilly, VA, and Seattle, WA.



THE LATEST IMAX FILM, from the team that produced *Fighter Pilot: Operation Red Flag*, explains how a century of trial and error in aircraft design and engineering resulted in Boeing's 787 Dreamliner and Airbus' A380. Boeing's chief test pilot, Mike Carriker, who is rated in more than 100 types of aircraft, serves as audience guide, interpreter, and flight instructor, taking moviegoers aboard a Stearman biplane, a sleek, swoopy Constellation airliner, an advanced Schleicher glider, a U.S. Marine Corps Harrier, and into the cockpit of the Dreamliner for that airliner's first flight. After its June premiere, the film will open in theaters around the world in both 2-D and 3-D.

moonsuit, or even the 1/10th-scale Gemini capsule.

The giveaway, held by NASA and the General Services Administration—which auctions off surplus, seized, and forfeited assets—gives government agencies first dibs. Next comes museums at NASA facilities such as the Kennedy and Johnson space centers, then other museums, then state universities, then public schools. “If such a piece of property can inspire young minds, then NASA has achieved its objective,” Kenney says, adding, “A real crowd pleaser is astronaut food.”

You might have a slim chance at a Phase VI shuttle glove bladder. For specifics, check out <http://gsaxcess.gov>.

PHIL SCOTT

>>> Air&Space Interview <<<

Raymond L. Puffer

FORMER AIR FORCE HISTORIAN

A HISTORIAN AT EDWARDS Air Force Base in California from 1994 to 2007, Raymond Puffer documented the history of the test pilot school, unmanned aerial vehicles, and the Airborne Laser.

What are you most proud of about your work at Edwards?

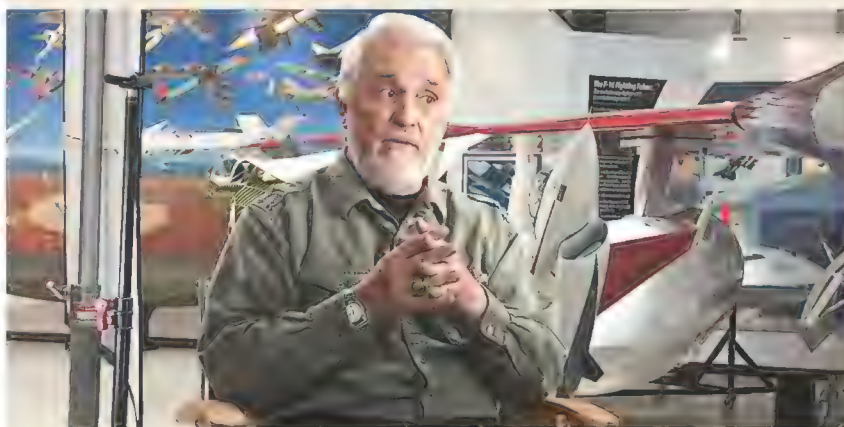
[Among other things], I felt really great watching the Airborne Laser make its first flight, or when the huge laser itself achieved “first light.”

Other high points?

Hearing unpublished Pancho Barnes stories from a woman who, as a youngster, lived in the ranch next to the Happy Bottom Riding Club. Or hearing Don Thompson, a young instrument technician in 1942, tell of riding in the improvised jump seat in the gun bay of the XP-59A Airacomet, the world's first and only open-cockpit jet plane.

Did you have contact with the families of deceased test pilots?

Joseph McConnell's daughter wrote. She was nine when McConnell died while testing an advanced version of the F-86H in January 1953.



Says Raymond Puffer on working at Edwards Air Force Base: “You never know what you're going to see, and once in a while you find yourself saying, *Now what the hell is THAT?*”

She visited and we explained how a broken elevator linkage crippled his plane, and that he tried to save it by flying back to the base using elevator trim for longitudinal control. At her request, one of the historians took her out to McConnell's impact site north of the base. Seeing the crater and some shards of metal allowed her to bring it to closure.

How did you document less-than-flattering moments in history?

When I was first approached about joining the Air Force History Program, I said: “Wow! Imagine spending a career writing squeaky-clean, sanitary success stories for your commander's signature! No thanks.” He replied: “We have a public affairs office that does that. Your job will be to tell the truth, warts and all.” The Air Force historian has carte blanche access to every piece of paper, and to every mind, in the Air Force. Denying the historian any information he requested would be a serious breach of Air Force regulations.

A retiring commander wanted me to know about a politically sensitive incident that occurred in testing a missile. He wouldn't say a word, but he called attention to his safe, and then left the room.

Read the entire interview at www.airspacemag.com

Sightings

PICTURES WORTH A SECOND LOOK

CAUSE FOR REFLECTION: The last scheduled night launch of the space shuttle program roused James Vernacotola in the pre-dawn hours of February 8. Vernacotola, who works in the IT field in Jacksonville, Florida, lives a few miles from the Palm Valley Bridge, which crosses the Intracoastal Waterway 115 miles north of NASA's Kennedy Space Center. It used to be a two-lane drawbridge until a higher, clear-span, four-lane bridge replaced it in 2002, and improved the view for night launches. "But one thing that I think nobody realized was that that section of the Intracoastal Waterway south of the bridge was pointed toward the Kennedy Space Center, which made it possible to photograph a reflection," says Vernacotola.

At 4:14 a.m., his lens took in the arc of *Endeavour's* ascent on the 32nd shuttle mission, STS-130, to the International Space Station, where the orbiter delivered the Tranquility node. During the 132-second exposure, the stars etched paths westward in the sky, while a waning moon crept in the same direction and gave the appearance of being full. NASA soon posted the image on the Astronomy Picture of the Day page of its Web site, calling it "Waterway to Orbit." Vernacotola has gotten high praise via Facebook and Twitter, and through his Web site, www.jamesvernacotola.com. "There was something about that photo that really spoke to people in a way I would have never expected," he says. "Not only was it visually appealing, but it seemed to embody what we can do as a country. It also seemed to have a nostalgic effect, since the manned space program is scheduled to be grounded for some time."





In the Museum

STOPS ON A TOUR THROUGH AMERICA'S HANGAR

Honor Roll

ON A STROLL ALONG THE PEACEFUL TREE-LINED WALKWAY leading to the National Air and Space Museum's Steven F. Udvar-Hazy Center in Virginia, you will see thousands of names. They're part of the Museum's Wall of Honor, a permanent memorial created of airfoil-shaped stainless-steel plaques honoring men and women who have had a passion for flight. Along with icons of aviation and space—the Wright brothers, Charles Lindbergh, Amelia Earhart, John Glenn—you'll find the names of people whose fame is not as great but whose love for flying has been as strong. We'd like to tell a few of their stories.

Major General William Gorton

"It never dawned on me that I wouldn't be a fighter pilot," says retired Air Force Major General William Gorton. His father, A.W. Gorton, was U.S. Navy aviator number 1,720, a test pilot, a member of the U.S. Navy racing team, and winner of the Curtiss Marine Flying Trophy.

"What surprised me," Gorton continues, "was that I ended up in the Air Force instead of the Navy. But that was on the advice of my father. In 1954 the Air Force was expanding and my father thought I would have a greater chance of flying fighters in the Air

Force. So in February 1954, I went up to Jacksonville, Florida, and enlisted in the aviation cadet program. From the first actual fighter I flew, the F-86, until the last fighter I flew the day before I retired—the F-16—I was fortunate to do exactly what I set out to do."

For six years, Gorton's ride was the F-100. "In 1956, I was full of attitude and not much brains, and the F-100 was by far the hottest airplane in the inventory at that time. And it had some fascinating idiosyncrasies about it. It taught me an awful lot."

Gorton is the president of the Super Sabre Society, which is dedicated to

honoring the history of the F-100 and the men who flew it. The Museum's F-100D is undergoing restoration; it will eventually be displayed at the Udvar-Hazy Center. Under Gorton's guidance, the Super Sabre Society has made a donation to reserve an airfoil. "It's a natural fit for our members to have their names inscribed on an airfoil leading up to the Museum," says Gorton.

Mary Dominiak

Mary Dominiak can't remember a time when she wasn't interested in aviation. "As a kid, anytime I heard an airplane engine, I had to look up and see what it was," she recalls.

Dominiak is a longtime supporter of—and donor to—the Museum. "When I heard they were going to build the Udvar-Hazy Center, I was in transports of delight," she remembers.

"The idea of having an air and space museum virtually in my backyard was irresistible." A resident of northern Virginia, she visits the Center frequently, and attends airshows whenever possible. "I think pilots are among the most positive people on the planet. There's a can-do and friendly vibe that you get when you go to an

airshow. There's always a very positive mindset, that you can do anything, go anywhere, and achieve anything, and have a gay old time while you're doing it." Dominiak added her name to the Wall of Honor because it combines

The Wall of Honor (below) is dedicated to honoring men and women who have a passion for flight, from enthusiasts like Mary Dominiak (her name, left) to military aviators like Colonel Oscar Mauterer (inset).



ARTIFACTS

Belated Accolades

DURING WORLD WAR II, they ferried airplanes within the United States, test-flew aircraft, and trained pilots, freeing their male counterparts for combat missions overseas. They were the Women Airforce Service Pilots, or WASP, and they were the first American women to fly military aircraft. At the 1944 graduation ceremony for the very last class of WASP, U.S. Army Air Forces General Hap Arnold said, "Frankly, I didn't know in 1941 if a slip of a girl could fight the controls of a B-17 in heavy weather. Now, in 1944, it is on the record that women can fly as well as men." Despite their sacrifices, the WASP



were considered civilians, and weren't granted veteran status until 1977. On July 1, 2009, President Obama signed a bill awarding the Congressional Gold Medal



(above, Museum collection) to the WASP in honor of their service; roughly 300 former WASP attended the medal ceremony on Capitol Hill on March 10, 2010.

two of her interests: history and aviation. "When you put those two things together, there's something very powerful. For me it's the chance to give back to something that has given me a lot of pleasure over the years."

Dominiak started working toward her pilot's license in the mid-1990s, but put it on hold without having soloed. "I ran into a problem that afflicts a lot of people: This business of having to work full time really gets in the way," she jokes. Dominiak is determined to complete her pilot's license, but achieving the goal may have to wait until retirement. "In the meantime," she says, "I just keep looking up."

Pam Cain

Pam Cain was almost 13 years old when her father, Air Force Colonel Oscar Mauterer, was reported missing in action over Laos. "I can remember the day like it was yesterday," she says of that winter morning in 1966. "I remember everything about it."

Mauterer piloted a Douglas A-1E Skyraider, providing cover for O-1E forward air controller aircraft. He hoped to enter the space program after his tour ended. But in February 1966, Mauterer's aircraft was hit by enemy fire. About five miles south of Na Phao in Laos, he was forced to eject. He has never been found.

When Cain heard about the Wall of Honor, she immediately thought of her father. "What better way to honor my dad's name? It seemed a very fitting way to make a tribute to him," she explains.

"I dearly love flying," Mauterer wrote in a 1965 letter to his daughter, "as it is a way of life that is difficult to fully describe but it is exhilarating..."

While Cain isn't sure how her father

became interested in aviation, she does know that his fascination with it indirectly influenced her future husband and their son to become pilots.

REBECCA MAKSEL

For more information about the Wall of Honor, visit www.nasm.si.edu/wallofhonor. Funds from this program are used to help preserve and restore the aircraft and spacecraft in the Museum's collections.

[Visitor Information]



Family Days "Become a Pilot" day takes place on Saturday, June 19, at the Museum's Steven F. Udvar-Hazy Center in northern Virginia. Enjoy educational activities and an outdoor aviation display with dozens of visiting vintage, recreational, military, and homebuilt aircraft. Admission is free, but parking is \$15; activities run from 10 a.m. to 3 p.m.



What's Up Receive regular updates on Museum events, read about artifacts, get detailed (and behind-the-scenes) exhibition information, and receive calendar listings, all by subscribing to the National Air and Space Museum's free monthly newsletter, *What's Up*. Sign up at www.nasm.si.edu.



National Air and Space Society Members of the National Air and Space Society are charitable donors who support the mission and programs of the National Air and Space Museum. Society membership offers advance access, invitations to special events in the Museum, and other benefits. Like *Air & Space* associate members, National Air and Space Society members receive *Air & Space* magazine and discounts. Unlike associate members, Society members make contributions that help fund the Museum's restoration, preservation, and education efforts. Both memberships support the Smithsonian Institution. For more information, visit www.nasm.si.edu/membership.

Above & Beyond

MEMORABLE FLIGHTS AND OTHER ADVENTURES

It's All Sawdust and Mirrors

A FEW YEARS AGO, I wrote in this magazine about Jeffrey Jacobs, a sidewalk astronomer who sets up his telescope on New York City streets and invites passersby to have a look at the night sky ("Moonstruck," Soundings, Oct./Nov. 2005). New Yorkers buy lots of telescopes, which is odd, because in Manhattan you can see only the moon, the larger planets, and the brightest stars. Some say New Yorkers use their telescopes mostly to gaze into neighboring apartments.

I took a few peeks through Jacobs' telescope myself, and later, when I moved to Florida, I decided I had to have my own, even if it let me see only the same heavenly bodies as Manhattan dwellers.

The price of high-end amateur telescopes quashed that desire, but then I learned about John Dobson, a former member of a Los Angeles Vedantan monastery who built a telescope from scratch: He ground mirrors from a ship's glass portholes, mounted them in a cardboard tube from a construction site, and built a telescope mount from scrounged lumber, all for about \$5. I called the monastery and left a message for him.

Then I consulted Google and found a site titled "How to Build a Dobsonian Telescope." It had photos of a cannon-like object and complex-looking calculations about setting focal lengths and whatnot, and recommendations to buy what I couldn't grind myself. It gave glowing reviews for Murnaghan Instruments of West Palm Beach, Florida. That company's Web site listed a six-inch Dobsonian Telescope component kit—

focusers, finder scope, mirrors, eyepieces, and everything else the homebuilder likely won't discover in a dumpster—for \$229.95. I called to order it, and Pat Murnaghan himself answered.

"Among people who don't have a lot of money to spend on high-end

one. With a store-bought telescope with computer-control nonsense, you have something that's going to work for a while, then it's going to break."

I bought the screws and bolts that the plans said I'd need, and called Murnaghan again to ask where I could get the tube to mount the optics. He

reminded me that Dobson had used a molding form for a concrete column. "The big concrete construction companies will throw you out the door," he told me. "You can find Quik-Tube at Lowe's."

Next up: Plywood for the mount. I waved down Jaime, my apartment complex's maintenance man, scooting around in a golf cart. "I need a half-sheet of plywood," I said. "I'm building a telescope." He motioned for me to follow him to the maintenance shed, where he pulled out an L-shape sheet. I took some quick measurements. Bingo. Jaime plugged in the power saw, and I spent the rest of the day measuring and cutting. UPS delivered a box of telescope innards that afternoon.

I studied the assembly plans, a mish-mash of verbiage probably written by a scientist. I spray-painted the inside of the tube flat-black. Then I called Murnaghan.

"I'm about to cut first cardboard," I said, playing on "first light," what astronomers call the first view from a telescope. He gave me a quick pep talk on building a telescope, adding that I really hadn't needed to paint the inside, despite what the plans said.

"All Dobsonians are ultimately Newtonian reflectors," he said. "Sir Isaac did all the work. What Dobson did was bring astronomy to the



Still life with telescope, feline, and feet. Even the National Air and Space Museum uses a Dobsonian telescope to show visitors the sun.

amateur scopes," Murnaghan said, "about the only way to get a decent, usable telescope that will let you do something beside stare at a couple of dots is either build a Dob or find a used

masses.” Galileo’s 1609 telescope magnified light; in 1668, Isaac Newton built a telescope that gathered light instead, using a large concave “primary” mirror mounted in the far end. After the mirror collected the light, it reflected the compressed image to a smaller flat mirror in the front, which reflected the image to an eyepiece.

“If it’s a Newtonian, why is it called a Dobsonian?”

“A Dob is more of a concept than a design,” he said. “He was working with nothing. His resourcefulness and ingenuity were enough that they ended up calling his a Dobsonian telescope.”

I began building in earnest that Saturday and worked straight through Sunday afternoon, gluing and nailing the plywood pieces together, none of which lined up because in my usual careless rush, I’d cut them out-of-square. They were thinner than the directions called for, but Murnaghan said I could build the thing out of cardboard if I wanted. It needed feet to stand on, so I went dumpster-diving for a piece of 1 x 2 wood. It called for holes larger than the two drill bits I had, so I used smaller bolts than the plans called for. When I ran out of new nails, I scrounged up bent ones from a junk drawer and straightened them. The only time I proceeded with great care and precision was mounting the optics in the tube.

Once again I called Murnaghan.

“Did you find the directions in the box?”

“The ones that say ‘Do not ever look at the sun with this telescope?’”

“That’s the one.” One page contained the calculations for determining the distance between the screw holes for the primary and secondary mirrors, which turned out to be 41.25 inches.

My largest drill bit didn’t make a big enough hole for the eyepiece, so I enlarged it with a box cutter. Directions called for a rotating base, which swiveled on a Formica square or an album, which meant sacrificing Leo Sayer’s *Endless Flight*. The last part: two round bearings necessary to adjust the tube vertically. I liberated the training wheels from a Spiderman bike someone had tossed in the garbage. Once I nailed those into place, I was done. There were pencil marks and calculations written on the plywood, flat black fingerprints on the yellow Quik-Tube, and all over the floor were undersize screws and nails, sawdust, and a spilled glass of iced coffee. But I was done.

I set it up and waited until dark. Using only the eyepiece, I tried to find something to look at other than the apartment complex across the street. I spotted three stars, but the image

It rained for the next three nights.

A couple of days later John Dobson called me back. He had returned to the monastery after he had a stroke in March 2008, although he still participates in star parties, where amateurs get together to compare telescopes. I asked him if he had that original telescope. “No,” he said. “Somebody borrowed it and set it up for ten years. They took the mirror out and left it set up in the rain, and we lost the rest of it.”

“What should I do with my telescope?” I asked.

“It’s only a little telescope,” he said. “It’s not very important what you do with it. What you need to do is get in touch with other people with telescopes when they have a star party. If you hob and nob with these people, you’ll eventually get to be a hobber and nobber yourself.”

I BEGAN BUILDING IN EARNEST THAT SATURDAY AND WORKED STRAIGHT THROUGH SUNDAY AFTERNOON, GLUING AND NAILING THE PLYWOOD PIECES TOGETHER, NONE OF WHICH LINED UP BECAUSE IN MY USUAL CARELESS RUSH, I’D CUT THEM OUT-OF-SQUARE. THE ONLY TIME I PROCEEDED WITH GREAT CARE AND PRECISION WAS MOUNTING THE OPTICS IN THE TUBE.

seemed blurry, about as stunning as the first views from Hubble before the initial repair mission to fix the optics. Disappointed, I plugged paper in both ends of the tube and put it away.

The next day I asked Murnaghan if I’d gotten it right, because it was a clear night and I saw only the three stars.

“Was the background gray?”

“Yes.”

“It was probably light pollution. Take it to a dark area and try again. Focus on the moon: It should come in clean and crisp.”

The following evening the sky was relatively cloudless and a sliver of the moon crept up. I hauled my not-very-important telescope out to a golf course and pointed it at what was visible of the lunar surface. Like Galileo four centuries earlier, I saw its imperfect, craggy surface, the mountains, the craters, and what the ancients thought were seas. Like Murnaghan said, the view was clean and crisp.

Then I turned my new telescope on the nearest apartment building.

PHIL SCOTT

Oldies & Oddities

FROM THE ATTIC TO THE ARCHIVES

A Different Kind of Hybrid

IN THE EARLY 1970s, Henry Smolinski, a California engineer formerly employed by North American Aviation and Rocketdyne, believed he had the solution to the intractable problem of how to combine an airplane and a car in a single vehicle.

Rather than start from scratch, he thought, why not take the wings, rear engine, and tail from a Cessna Skymaster and attach them to an existing car in such a way that they could be conveniently disconnected? The Skymaster, Cessna's attempt at a twin that would be easy to control after an engine failure, had a high wing, engines at both ends of the fuselage, and tail surfaces supported on booms projecting aft from the wings. It seemed tailor-made for Smolinski's scheme, as did the Ford Pinto, an inexpensive, low-slung compact that was lighter than most American cars.

With the irrational optimism that often afflicts great dreamers, Smolinski announced that his auto-plane hybrid, dubbed Mizar after a binary star in the Big Dipper, would be available in 1974 for under \$30,000—less than the price of the airplane that had to be cut in two to make it. He arranged for the Mizar to be sold by a Sepulveda, California Ford dealership.

I was building an airplane at the time, and Smolinski sold me the Skymaster's front engine to use in it, so I followed his progress, though with considerable skepticism. I heard he had obtained a larger, three-blade propeller for the remaining engine, which was having a hard time dealing with the weight of a complete car and three-quarters of an airplane. After some taxi tests at Van Nuys Airport, Smolinski and Harold Blake, his partner on the



The first flight of the Mizar in 1973 would soon be followed by its last.

project, moved the Mizar to Ventura County Airport in Oxnard.

On September 6, 1973, I flew my airplane for the first time. The ex-front engine of Smolinski's ex-Skymaster worked nicely.

Five days later, I learned that things had not gone so well for its sibling. As the Mizar climbed through 400 feet on a test flight, the strut securing the right wing had broken free from the Pinto. The wing went up and the rest went down, killing Smolinski and Blake. I heard a report that the strut had been attached to the sheet metal sill below the car's door with cheap commercial blind rivets or sheet-metal screws, but it seems hard to believe that a professional engineer like Smolinski would use such inadequate fasteners. The National Transportation Safety Board's report mentioned a bad weld, which is a little more plausible.

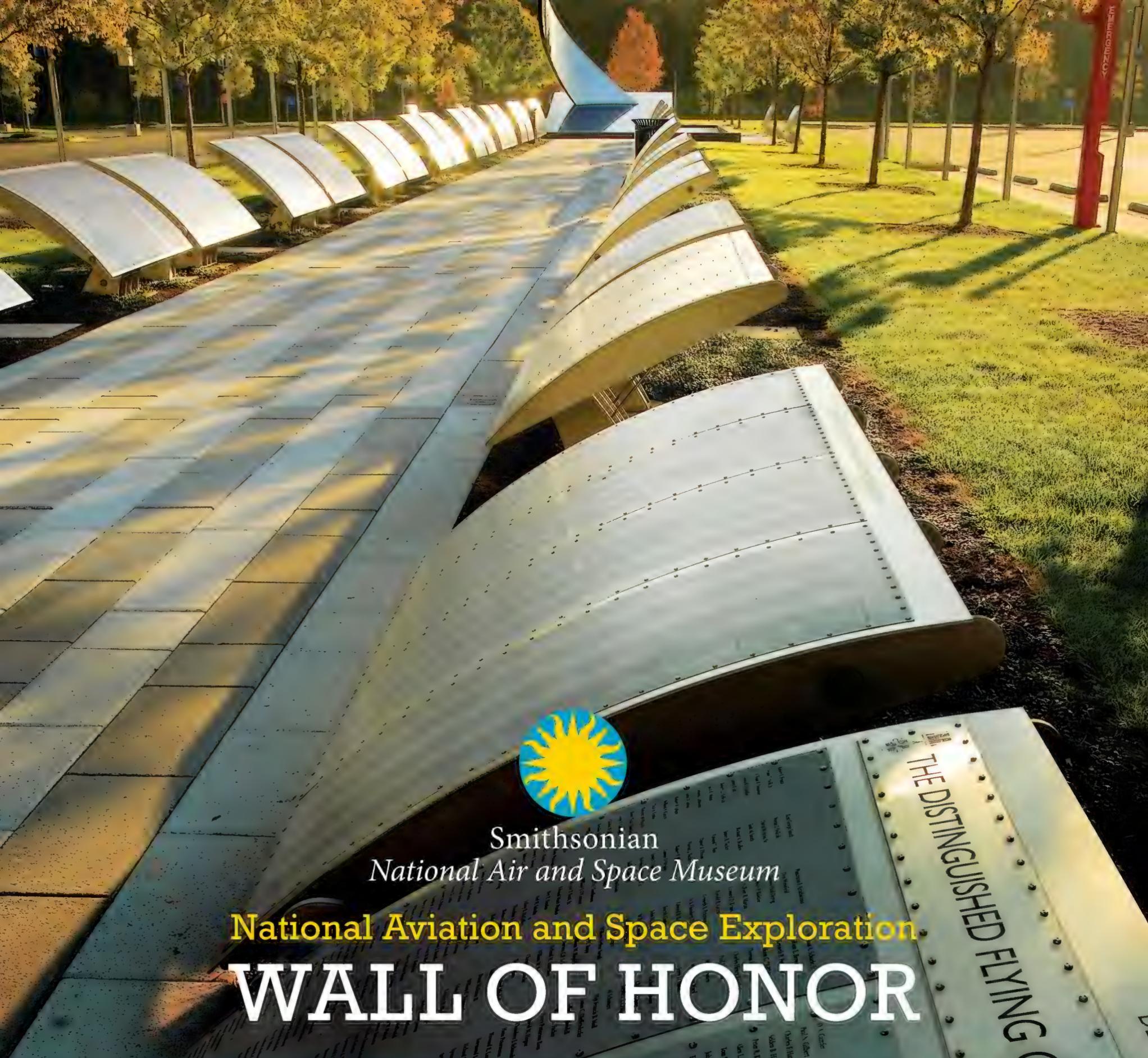
Although the Mizar project, like most flying cars, seemed just a bit ridiculous, there was a grain of sense in it. The regulatory obstacles to an airplane-car hybrid are as formidable as

the technical ones, and obtaining government approval for even conventional airplanes and cars is a long, costly process. It was logical to use already-approved components. Whether the hybrid could ever have obtained Federal Aviation Administration certification, however, is doubtful. Neither the car nor the airplane could have been used in their original configurations; the Cessna's wing was not designed to support something as heavy as a Pinto, and the Pinto's structure and controls did not lend themselves to convenient integration with an airplane. Smolinski must have hoped that a few successful flights would whip up additional investment so he could work out a happy marriage between two machines that were, in engineering terms, natural enemies.

Thirty years later, Smolinski might have found in a Smart Fortwo or in the original two-seat Honda Insight a more suitable mate for that cruelly amputated Skymaster.

 PETER GARRISON

©BETTMANN/CORBIS



Smithsonian
National Air and Space Museum
National Aviation and Space Exploration
WALL OF HONOR

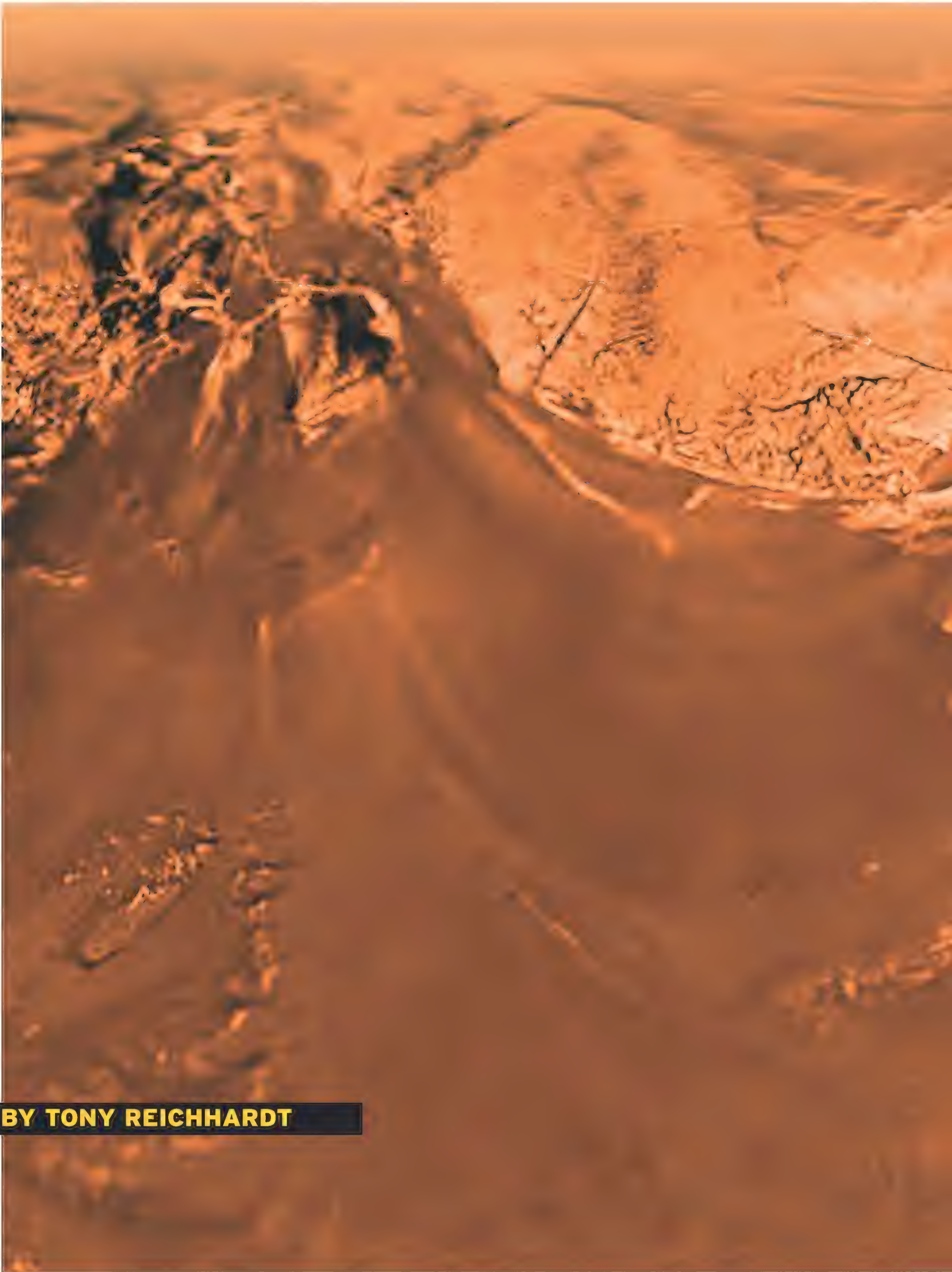
Here's your chance to have your name recognized forever...

Help complete the Steven F. Udvar-Hazy Center by contributing \$100 or more
and your name, or the name of someone you wish to honor,
will be seen by millions of visitors for generations to come.

You will also receive a handsome **Certificate of Registry** suitable for framing and
have the opportunity to submit a Wall of Honor profile to the Museum's database.

To make a Wall of Honor donation, visit www.nasm.si.edu/wallofhonor

If you have any questions, contact the National Air and Space Society
Membership Office at nasmwallofhonor@si.edu or 202.633.2603.



BY TONY REICHHARDT

TITAN AIR

SATURN'S MYSTERIOUS MOON MAY HAVE AIRPLANES IN ITS FUTURE.

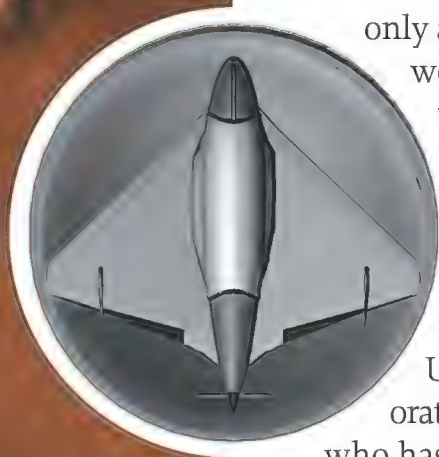
IN HIS 30-ODD YEARS designing aircraft, Rick Foch has, believe it or not, seen trickier problems than this one. His shop at the U.S. Naval Research Laboratory in Washington, D.C., has invented dozens of unmanned aerial vehicles of all shapes and dimensions, from a UAV that folds up in a Marine's backpack (Dragon Eye, 2000) to a small drone launched from a Predator (Finder, 2000) to a winged radar target that can withstand 10,000 Gs while being shot from a ship's gun (FLYRT, 1991).

Foch understands the difficulty of sending a robot airplane to fly, with almost no human supervision, for a full year in an alien atmosphere nearly a billion miles away—around Saturn's moon Titan. But it's doable, he says. You want tough? Try designing an airplane for Mars. Foch has done that too.

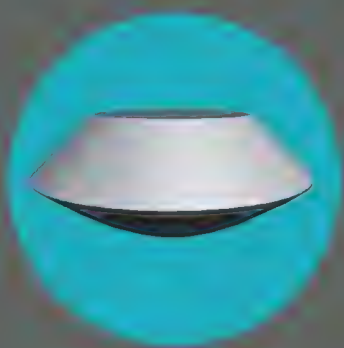
Of all the worlds in our solar system, only a few have atmospheres that would allow winged flight: Titan, Venus, Mars, Earth, and the outer gas planets. Aerodynamically, Titan is by far the best place to fly airplanes. Ralph Lorenz, a planetary scientist at the Johns Hopkins University Applied Physics Laboratory near Baltimore, Maryland,

who has made this exotic moon his object of study, calls it "an aviator's paradise." Never mind that it rains methane there, and is so cold that water turns hard as granite. Titan's atmosphere is thick—four times as dense as Earth's—and the pull of gravity is only one-seventh what it is here. That combination makes it ideal for generating aerodynamic lift, so

From images sent by the Huygens probe in 2005, scientists created this view of Titan from 30,000 feet – about the altitude at which an airplane would cruise.



Drop, Open, Fly



AVIATR's design will change, but some things are certain. The airplane has to be packed inside a heat-resistant entry capsule, which would parachute into Titan's atmosphere before opening to release the airplane. Cruising speed is a relaxed 25 miles per hour.

flying on Titan takes far less power than a comparable flight on Earth.

Larry Lemke, an aerospace engineer at NASA's Ames Research Center in Mountain View, California, started studying the problems of extraterrestrial flight in the 1980s. He well knew the terrible constraints that space engineers suffer every day—especially the tight limitations on power, mass, and volume. What he needed was a collaborator from the aeronautics world who wasn't fazed by those re-

quirements. "When I got into studying Mars airplanes, 20 years ago or so, I looked around to figure out who I would want to work with," Lemke says. "I understood all the space systems, and am an aeronautical engineer, so I knew how to design airplanes. But the tricky part was how to design airplanes that have strange configurations and—oh, by the way—need to deploy in midair and fly away. So I went around to all the usual suspects—the Skunk Works, Burt Rutan, AeroVironment, and so forth. They're all very, very competent airframe designers and builders, but almost none of them had ever built a folding airplane. And by that time, Rick Foch had already built eight or ten. All the vectors pointed to him."

Lemke and Foch have been collaborating, off and on, ever since. Their most recent Mars airplane concept, called Matorador, won enough NASA R&D funding to advance to wind tunnel tests in 2006. Now they're working together on a proposal for a Titan airplane called AVIATR—Aerial Vehicle for In-situ and Airborne Titan Reconnaissance—which scientists at Ames and other centers are pitching as a can-

didate for NASA's next \$425 million Discovery mission, scheduled to launch in 2016. If selected (the winner will be chosen in 2012 or 2013), it will be the first airplane built for another world.

Titan is more than just a convenient place to fly. It has become in recent years a prime destination for planetary scientists. It's the only world we know of, beside our own, with lakes of liquid (in this case methane), and due to its abundance of organic chemicals, some researchers consider it the perfect laboratory for studying the origins of life. After the European Huygens lander touched down on the moon's surface in 2005, scientists immediately started planning a return. "Everybody was instantly talking about mobility," says Lemke. A winged vehicle could cover a lot more territory than a rover, so the advantages of flying are obvious. And on a moon perpetually covered by clouds, an airplane flying under the haze could "do the equivalent of satellite reconnaissance." Hence, AVIATR.

Foch, whose title at NRL is Senior Scientist, Expendable Vehicles, takes the same approach to designing a Titan air-



ILLUSTRATIONS: CONCEPT DESIGN, LAWRENCE LEMKE/RICK FOCH; CONCEPT RENDERINGS, SEAN BAIN/U.S. NAVAL RESEARCH LABORATORY (5); TOP: NASA/JPL/UNIVERSITY OF ARIZONA

plane that he would for a drone launched from a ship or Humvee: “We always start with the container.” AVIATR would travel to Saturn packed in a clamshell-like entry capsule, which upon arrival would parachute into Titan’s atmosphere. The clamshell’s heat-resistant bottom drops away, AVIATR is released, and the airplane noses into the airstream and levels off. Its speed at deployment is leisurely—a mere 25 mph. (A Mars airplane, by contrast, separates from its parachute at nearly the speed of sound, then has to unfold and begin flying in a matter of seconds. Lemke calls it the “death plunge.”)

To get enough lift in the thin air around Mars, airplanes require large wing areas, making them “diaphanous and fragile,” says Lemke. But for Titan’s dense atmosphere, an airplane can be as stubby and rugged as a C-130—which, Lemke points out, can fly through a hurricane. The latest iteration of the AVIATR design has a delta shape with a 11.4-foot wingspan, sized neatly for a 13-foot entry capsule. “Compared to a Mars airplane, it’s wonderful,” says Foch. “We don’t even have to fold the wings.”

Once released in the atmosphere, AVIATR would fly slow hawk-like circles over the Titan landscape, taking photos and spectra of the surface, which would remain in constant sunlight. Depending on the target, controllers on Earth could direct the airplane to fly at different altitudes, from a low of two miles (safely above the mountains) to a ceiling of almost nine, where icing becomes a risk.

The mission would last a year or more. The technology that makes such a long-duration flight possible is a new type of nuclear battery called an Advanced Stirling Radioisotope Generator, or ASRG, which NASA is developing for the 2016 Discovery launch. Lighter and more efficient than the plutonium batteries used on current planetary missions like Cassini, the ASRG would drive the airplane’s pusher propeller, power the instruments and communication antenna, and provide heat when the outside air is minus 350 degrees Fahrenheit.

At those ridiculous temperatures, you would expect materials to be a worry, but AVIATR will be made of fiberglass, the same stuff used to construct the containers that store liquid helium. Problem solved. Lemke and Foch say their biggest con-

cern is the longevity of the electronics, actuators, motors, computers, and other small components. “No one’s ever built an airplane that can fly a year or two,” says Foch, because no one has had to. Reliability will be a must, and critical parts will need backups.

Turbulence is a minor concern; Titan’s air is obviously not as well understood as Earth’s. The only direct experience with the lower atmosphere that Lemke and Foch have to go on is Huygens’ parachute drop in 2005. The feeble sunlight on Titan doesn’t deliver much energy, so winds should be light, but just in case, the engineers are designing the airplane to be as inherently stable and self-correcting as possible. More than any airplane in history, AVIATR will be on its own.

Since NASA spacecraft operate so far from home, they’re designed so that if they lose orientation, they go into “safe mode”: Find Earth or some other recognizable target, lock onto it, and await instructions. AVIATR’s equivalent of a safe mode will be a Dutch roll—a steady side-to-side rocking that would prevent the airplane from going into a graveyard spiral down to Titan. The designers have come up with a modifier vane—a “unique feature of this airplane,” says Foch—that could pop up from the nose to add later-

al stability if AVIATR’s autopilot fails.

Foch and Lemke plan to verify the effectiveness of the flight controls in wind tunnel and atmospheric tests before launch—if there is a launch. AVIATR will have to compete for the 2016 Discovery slot, which is sure to draw at least a dozen other clever, well-thought-out proposals.

Ralph Lorenz of the Applied Physics Lab loves the idea of flying around his favorite moon. He has even designed his own two-pound UAV, which he calls the Titan Bumblebee, for hovering over the surface. But for this Discovery round, he is part of a team proposing a different concept. Called TIME, for Titan Mare Explorer, it would land a floating spacecraft on one of the moon’s methane lakes. Lorenz thinks an airplane may well be included on some future multibillion-dollar expedition to Titan, but figures NASA might be nervous gambling an entire Discovery mission on its first extraterrestrial airplane—which some people still consider a pretty far-out concept.

Not Rick Foch and Larry Lemke, who have been quietly working that problem for years. AVIATR is probably their most advanced vehicle yet, and their best shot at moving beyond the prototype stage. And somewhere on Titan’s dim, frozen surface may be their Kitty Hawk. ➔

NASA/JPL/SPACE SCIENCE INSTITUTE



Titan’s thick atmosphere, seen in natural color by Cassini, obscures the surface from view. But in images taken at other wavelengths (opposite), some landforms are visible.

TRUCK KILLER

FOR ONE MISSION IN VIETNAM, THE BEST AIRCRAFT FOR THE JOB WAS A BOMBER FROM WORLD WAR II.

"I WAS BORN 25 YEARS LATER than I should have been," muses former U.S. Air Force pilot Tim Black, a veteran of two tours in Vietnam. "I grew up enamored with World War II pilots and planes."

Born late or not, Black flew combat missions in a World War II airplane. Dropped World War II-era bombs. Even fired leftover .50-caliber World War II bullets.

But that's not why he volunteered to fly the Douglas A-26 Invader in Southeast Asia in the 1960s. In fact, at the 2009 Air Commando Association reunion in Fort Walton Beach, Florida, every crewman asked

BY DAVID LANDE said that the old bomber's appeal had nothing whatsoever to do with historical legacies. "A-26s were the best for the mission," says pilot Jay Norton, echoing the sentiment of all on hand.

Even in the fast company of F-4s and F-105s, as well as many other types that attacked traffic on the Ho Chi Minh Trail, the A-26 became known as "the best truck killer in Southeast Asia." It had just the right combination of firepower, loitering time, and ruggedness.

In November 1940, the Army Air Corps asked the designers at Douglas Aircraft to create a replacement for their own A-20 Havoc light bomber

and, if possible, to surpass North American's B-25 Mitchell and Martin's B-26 Marauder as well. "Engineers and technicians tried to make sense of the comments from the field regarding the shortcomings of the A-20, B-25, [and] B-26, and shape a next-generation aircraft," says Dan Hagedorn, senior curator at Seattle's Museum of Flight. "The A-26 was far more agile than any of these three, and flew more like a fighter."

After an impressive prototype dazzled the brass by exceeding performance parameters and outperforming the A-20, the government immediately



Banking across the Mekong River, an A-26A (above, ca. 1966) is loaded to attack enemy truck convoys moving supplies. Left: A Viet Cong camp and supply depot near Da Nang is destroyed in 1963 by an Invader's multiple bomb strikes.



placed an order. But when design changes and tooling difficulties delayed production, excitement stalled. And challenges in the manufacture of the airplane's wing spars (not the last time wing spars would haunt the A-26's story) kept production exasperatingly slow. So slow that General Hap Arnold, commander of the U.S. Army Air Forces, grouched, "I want the A-26s for use in *this* war, not the next war." The irony, of course, is that Invaders would fly in the next war—and the next.

But the aircraft did make it into World War II. In late 1944 and early 1945, A-26s reached the European theater and the Pacific. The aircraft had a crew

of three—pilot, navigator, and a gunner who operated upper and lower remote-controlled turrets much like a B-29's. Pilots came to appreciate the A-26's agility and punch. But the various delays kept the total number built by the end of World War II relatively small, with only 2,451 put into service—a quarter of the number of B-25 Mitchells.

In 1948, the military made a switch that would lead to confusion among historians for years to come: The A-26 was redesignated the B-26. The confusion still persists. The B-26 Marauder, manufactured by Martin during World War II, had been retired from the Air Force inventory by 1948. Decades later, John



DOD (DVIC)

During the Korean War, Invaders racked up 55,000 combat sorties (a training flight over Japan, above). Opposite, top: Bombing dock facilities ca. 1951, Wonsan, North Korea. B-26s would drop the last bombs of the Korean conflict, minutes before the cease-fire.

Moench, a retired major general who had been in the Air Materiel Command early in his career, wrote an explanation for the B-26 Marauder Historical Society: “[The Air Force] had no trouble converting a P-51 to an F-51 or a P-80 to an F-80. But, when it [came] to the A-26, there was a dilemma. To preserve the Martin B-26 ‘Marauder’ nomenclature, following my suggestion, the initial attempt...was to pick up a new number...as the next numbered ‘B’ in the sixty series. But [others] did not like this as it upset the progressive numbering attached to advancing design.... As a result, with a lot of reluctance and since there was no Martin B-26 ‘Marauder’ left in the inventory...[the Douglas] ‘A-26’ became the B-26. I resisted the idea as long as a major could, but I never foresaw the extent to which later confusion would arise.” Adding to the confusion, the Invader would have its “A” (for “attack”) designation restored in 1966. To this day, all who flew the Invader from the late 1940s until the early 1960s—including the prologue of Vietnam—still call the aircraft the B-26; those who flew it earlier and later call it the A-26.

About 450 Invaders saw frontline action during the Korean War. The airplane had its problems—especially a top speed half that of the 687-mph F-86 Sabres and MiG-15s—but found a niche in truck and train destruction. The B-26 dropped the first bomb in North Korea and the last bombs of the con-

flict, just before the armistice in 1953. Then most went straight to storage, or were sold to other countries for counter-insurgency duties.

EARLY IN THE VIETNAM WAR, most Invaders were essentially still in their World War II configurations, but without a gunner’s position and the two gun turrets.

From late 1961 through 1964, the old airplane flew mostly in bombing and close-air-support roles against guerilla concentrations—an operation code-named Farm Gate. Initially, the unit was benignly called the 4400th Combat Crew Training Squadron (a Vietnamese airman was required to fly in the third seat, behind the navigator, to uphold the pretense of training), and eventually was renamed the 1st Air Commando Wing.

When Air Force crews arrived in Southeast Asia, some of the 25 Invaders that saw action during Farm Gate were already there, likely ones that the CIA had used for clandestine operations in Laos and elsewhere. “The airplanes were old, and not in very good shape,” recalls Gary Pflughaupt, a navigator who arrived at Bien Hoa, the Farm Gate base near Saigon, in November 1963. “Minor maintenance had been done, but the structural aspect of the airplane was never checked, and ultimately there was metal fatiguing. They were just falling apart.”

Tom Smith, a pilot who arrived in July 1963, re-



calls, "When I stepped off the plane at Bien Hoa, I heard something overhead and looked up to see a B-26 coming into the landing pattern. As he pitched out [peeled off], the plane made this whistling sound. I thought he had a turboprop engine. As it turned out, what I heard was air passing over the holes in the plane—they whistled like when you blow over a bottle."

Losses on several missions raised questions about causes, but no crew had survived to tell if they had been brought down by enemy action or structural failure. "There was some suspicion of [failure], but because of the way the airplanes were lost, nobody ever saw it happen," says Pflughaupt. "The presumption was they were shot down." A lot of stories from forward air controllers, or FACs, both Vietnamese and American, hinted otherwise.

The squadron kept flying. "They put a big old G-

meter up there in the cockpit and we weren't to exceed 3.5 Gs," Smith says. For self-preservation, pilots obeyed. Did crews worry? "I didn't pay any mind to the wing," says Smith's navigator, Francis Hayes. "It was the guys on the ground shooting at us that I worried about."

On typical night bombing missions to the Mekong Delta, there were plenty of guys on the ground shooting. "Particularly when you dropped napalm," says Hayes. "You knew you'd take fire because it would light up the underside." Smith says his aircraft returned with battle damage "all the time, often near the trail-

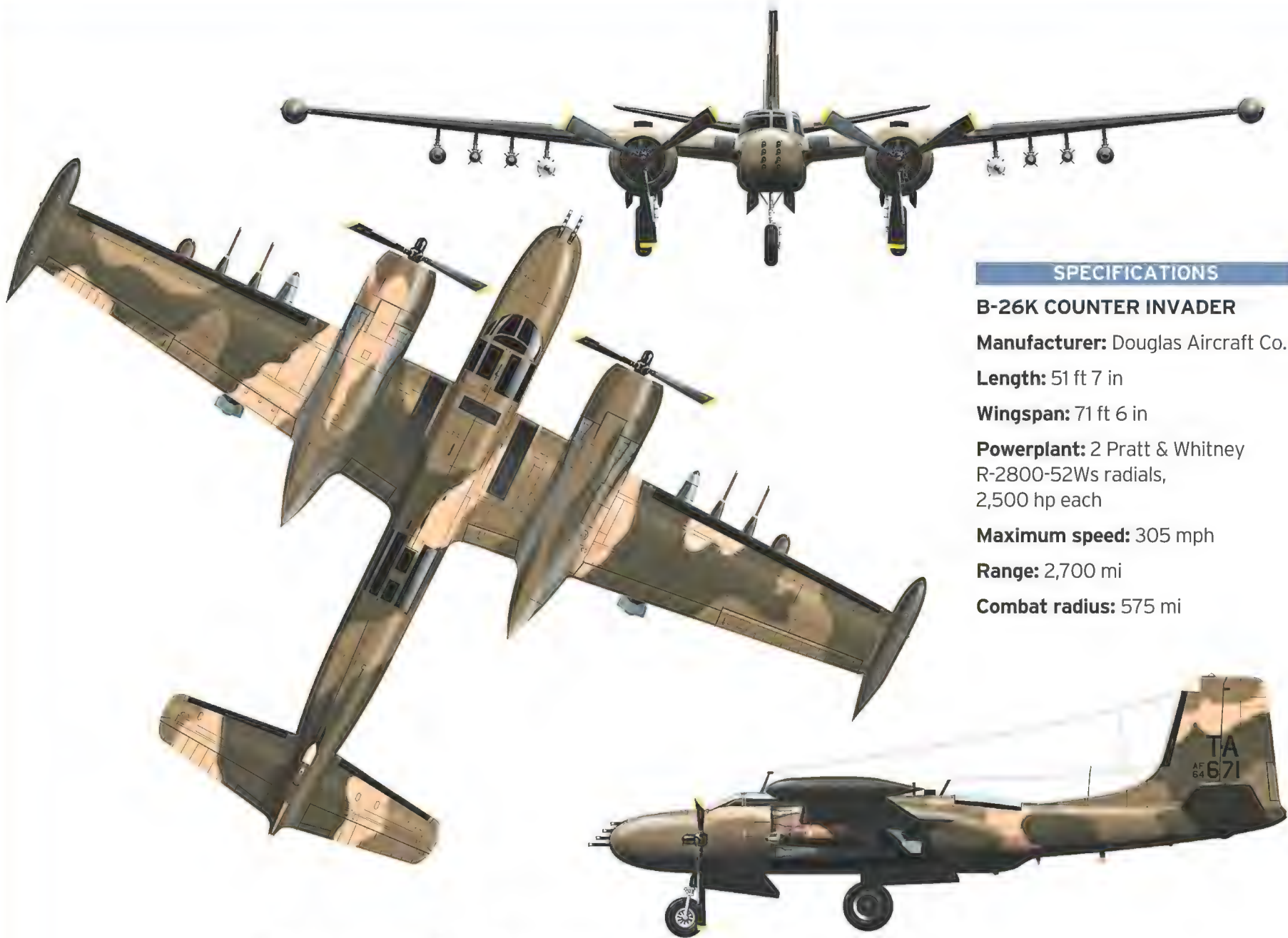
ing part of the wings or rear fuselage. Small arms, .50-cal. A whole unit would stand up and fire a burst." Hayes has firsthand proof: a spent .45 round that came up through the Invader's cockpit floor. It was the caliber used in Thompson machine guns, M3 "grease guns," and various others in the hands of the enemy. The A-26's underside was not armored, and the round tore through the thin aluminum easily. Hayes reflects, "If they shot at you, you knew you were in the right spot."

The unit had "one and a half crews per bird"—enough, Hayes recalls, for crews to fly about every other night. But suddenly, in February 1964, an urgent order cancelled all missions.

"The final straw was when a B-26 wing came off on a demonstration

The 609th Air Commando Squadron flew out of Nakhon Phanom airfield in eastern Thailand (below, left). Pilot Jay Norton (at left) and navigator Tom Bronson teamed up to fly the Counter Invader in 1968.





SPECIFICATIONS

B-26K COUNTER INVADER

Manufacturer: Douglas Aircraft Co.

Length: 51 ft 7 in

Wingspan: 71 ft 6 in

Powerplant: 2 Pratt & Whitney R-2800-52Ws radials, 2,500 hp each

Maximum speed: 305 mph

Range: 2,700 mi

Combat radius: 575 mi

Extreme Makeover, Bomber Edition

A-26 aircraft from World War II and those that flew as B-26s in the Korean War were upgraded in 1964 and given a new designation, the B-26K (in May 1966 the aircraft would go back to its attack designation). Modifications included wingtip tanks, additional nose armament, external racks, and square-tipped propellers.



As a navigator in the Douglas A-26 Invader, Frank Nelson flew some 185 missions.

flight on Eglin's Range 52," says Pflughaupt, referring to Hurlburt Field, an auxiliary field of Florida's Eglin Air Force Base where B-26 crews were trained. The cause of the crash: wing spar failure. The airplanes were grounded.

THIS COULD HAVE SPELLED

the end of the Invader story, but instead the Air Force awarded a \$16 million contract to a company called On Mark Engineering in Van Nuys, California, to rebuild 40 B-26s.

Most Invaders picked for makeovers came from the boneyard at Davis-Monthan Air Force Base in Tucson, Arizona, where, according to Hagedorn, 300-some Invaders were parked in the ready-for-ingots section. The new designation: B-26K.

Visible changes included permanent wingtip tanks, a slightly taller rudder, new underwing pylons, eight .50-caliber machine guns in the nose, dual controls (as opposed to pilot side only), new instruments, and radios. Invaders that still had dorsal and ventral turrets lost them. Performance modifications included improved Pratt & Whitney R-2800-52W radial engines with water injection and 2,500 horsepower (replacing the 2,000-hp version of the R-2800s) with fully reversible Hamilton-Standard props. The contractor also partially rebuilt the fuselage and tail, redesigned the wings, reinforced wing spars, and installed brake components from the much larger KC-135. No more G-force restrictions.

Smith and Hayes picked up a fresh B-26K directly from On Mark at Van Nuys Airport. "It was like a spanking new airplane—smelled like a new Volkswagen," Smith says. He thinks for a moment, then continues: "The plane flew the same. But more gee-whiz. More powerful, more solid—you could tell in the takeoff. A good bit more power. And you

TOP: HARRY WHITVER; LEFT: COURTESY OF FRANK NELSON



COURTESY OF KEN YANCEY

uary 1968. Both had completed an overseas tour and were teamed up during training at England Air Force Base in Louisiana after they chose A-26s. “I had flown C-7 Caribous,” Norton says. “The first time I got shot at, I searched for a way to shoot back. That’s how I decided on A-26s.” Bronson opted for the Air Commandos after seeing A-26s lighting the trail on C-130 flareship missions.

When the Counter Invader debuted in Southeast Asia in 1966—the 609th Air Commando Squadron later absorbed the mission—it became known for its permanent call sign: “Nimrod,” a Biblical reference to Noah’s great-grandson, “a mighty hunter.” Thereafter fliers in the unit were called by the same nickname: The Nimrods.

They were based at Nakhon Phanom in eastern Thailand. The Royal Thai government did not want “bombers” based there flying against its neighbors, so in May 1966 the Invader’s name changed from B-26K back to an attack designation, A-26A, since an attack plane was not technically a bomber. Besides, the airplane didn’t look like a bomber; it was much trimmer and sportier.

Shortcutting through Thailand’s neighbors Laos and Cambodia, the Ho Chi Minh Trail was a vital artery for communist supplies that were being shuttled from North Vietnam to South Vietnam. It has been called an ingenious logistical network: mostly hidden under the jungle canopy, trucks could travel on dirt or gravel roads that split into multiple routes, with numerous truck parks, fuel and ammo dumps, barracks, and command facilities along the way. U.S. commanders realized night interdiction here was crucial, and “choke points” on

After circling the Ho Chi Minh Trail, Ken Yancey’s A-26 (left) was targeted by North Vietnamese gunners who shot out his tail section – the third time that happened. Repair crews had the aircraft back on the line within five days.

could carry more.”

You could not only carry more, you could also carry it faster and farther: Maximum armament load increased from 7,500 pounds to 12,000—still 4,000 pounds internal, but now 8,000 under the wings. Maximum cruising speed went up to 305 mph, 29 mph faster. And thanks to the wingtip tanks, combat radius increased to 575 miles, up from 241.

THE K MODEL came packing an extra-wide variety of ordnance, from LAU-3A rocket pods to 750-pound M117 general-purpose bombs—and a whole lot of attitude. It also carried several thousand rounds of .50-caliber ammunition for the eight nose guns. Favorites for truck busting were the World War II M31 and M32 thermite incendiary clusters (referred to as “funny bombs” and shaped like water heaters with fins) and 500-pound BLU-23 and 750-pound BLU-27 finned napalm bombs.

“I don’t know of anyone who wanted to bring ordnance back home,” says Jay Norton, who arrived in Southeast Asia with navigator Tom Bronson in Jan-



All members of the 609th Air Commando (later Special Operations) Squadron wore the A-26 “Fly By Knights” patch on their flightsuits. Crew members of the 609th with their upgraded Counter Invader, ca. 1968.



RIGHT: COURTESY OF KEN YANCEY; OPPOSITE: COURTESY OF JAY NORTON



Though a bullet severed his rudder cable, pilot Jay Norton managed to land his B-26 (above, in 1963). Bottom: In 1964, On Mark Engineering rebuilt 40 Invaders for the Air Force; increased armament and combat radius were just two improvements.

the trail in Laos became prime hunting grounds.

Bronson describes an average night over the trail: "We typically flew at 5,500 to 6,500 feet, navigating with TACAN [Tactical Air Navigation, which provided bearing and range], and we'd drop to 2,000 to 3,000 feet over the target area. The FAC would drop one to three logs [ground flares that glowed like firewood]." The controller then radioed the elevation of the target, terrain, and obstacles to look out for, and recommended attack and exit headings. "The FAC used a starlight scope to help him see movement on the trail, and he'd radio where it was, saying, 'Trucks are 100 meters northeast of the log.'"

The navigator armed the ordnance, and the pilot nosed the A-26 down into a 30-degree dive. During descent, the navigator would call out altitude while the pilot concentrated on the logs and rapidly approaching target. "Then I'd pickle and pull [drop the bombs and climb]," Norton says. Sometimes a single truck would go up in flames, sometimes a huge secondary explosion indicated a hit on a truck park, and other times a pass resulted in just a cratered moonscape.

During this time, A-26s flew individually, taking off at intervals through the night to fly over assigned sections of the trail. "But we were far from alone," says Bronson. Besides the FAC flying in an O-2, C-123, or C-130, the A-26s might be joined by "a C-130 dropping flares, Navy A-4s that didn't have targets in Vietnam, [or] our own F-4s and B-57s over

the trail. It could be quite crowded airspace. Mid-air collisions were a real concern. We went through jet wash sometimes."

While the fast movers came and went quickly, A-26s stayed over the target area. "With plenty of gas, we could wait for something to develop," says Norton. That also gave enemy gunners plenty of time to take aim. Enemy action and other causes brought down a dozen A-26As. Crews routinely took fire from unseen 37-mm and sometimes larger guns, hidden by the darkness and jungle canopy. "The longer the tracer gets when it goes by, the closer it is," Norton says. "When we saw tracers coming closer, I would break left or right."

Norton shares one of the tricks for flying the twin-engine Invader: "To keep the gunners guessing...we kept the props out of sync. It causes a *hmmm mum mum* sound that, to a person on the ground, is very hard to tell where the sound is coming from." But even the best tricks could not always stop determined North Vietnamese gunners from finding their mark; still, when they did, "the airplane was terribly rugged—it brought you back home," says Norton.

Just ask Ken Yancey. His aircraft sustained battle damage bad enough to warrant the complete replacement of his tail section—three times. All were 37-mm hits to the stabilizers—vertical, horizontal, or both—followed by bone-shuddering flights back to Nakhon Phanom. But in 217 missions, enemy gunners never brought Yancey down.

He has only praise for the airplane. "It was like flying a fighter," he says. "The airplane would do what I wanted it to do."

"Such a nice plane to fly," says Smith. "You won't find anybody who's flown it that wasn't really impressed with it—before or after the conversion. It had a mystique, a charm to it. It's what brings us here [to the reunion]." Smith's claim held up at every table of the reunion's hospitality room (or as



TOP: COURTESY OF JAY NORTON; LEFT: COURTESY OF FRANK HAYES





the attendees called it, the “hostility room”). Pressed to identify the airplane’s vulnerabilities, they grudgingly gave up only two: “no ejection seats” and “too slow for daytime.” “Our salvation was flying in the dark,” says navigator Frank Nelson.

THE PUSH FOR AN ALL-JET AIR FORCE is what some Air Commandos believe brought an end to their missions in November 1969 and retirement of the A-26. The warplane had seen service in three wars spread across three decades, never quite getting pushed out of the inventory because it always managed to find a niche, even while performing its work in the same low-tech, dive-bomb, shoot-’em-up way it had since World War II. This time, though, the airplane would stay retired for good.

Tim Black and his navigator, Bruce “Gus” Gustafson, ferried one of Nakhon Phanom’s 15 remaining A-26s back to the States, island-hopping across the Pacific with fuel stops at some legendary World War II locales: the Philippines, Guam, Wake, Midway, and Hawaii’s Hickam Field. The two had

trained as a crew, flown combat as a crew, taken Combat Time Off together in Bangkok. And together they brought home an A-26. One night at the reunion, seated side by side (perhaps because it felt most natural, Gustafson in the right-hand chair—the A-26’s navigator’s position), they tell the story: “We landed at Davis-Monthan and taxied over to the boneyard side of the base,” Black recalls. “We went through some gates where you’re supposed to park your airplane to get it ready to put into storage. A guy chocks us, then comes over and says, ‘Shut ’em down.’ We say, ‘No.’ He says, ‘Shut ’em down.’ After several *nos*, the guy finally walks off and leaves us sitting there.”

The two glance at each other, flashing back to a moment frozen in time, circa January 1970, and say in unison, “We still have gas.” Then Gustafson chimes in, “And it’s still our airplane.” Black shrugs, “And it might be the last time this airplane flies.” The pair remembers staying there 15 or 20 minutes more, just sitting in the cockpit, with the engines running. ✈

By the end of World War II, the U.S. Army Air Forces had rated the Invader its best twin-engine bomber. Although jet-propelled bombers replaced the A-26 in frontline squadrons in Vietnam, the Invader would succeed in a second mission: counter-insurgency warfare.

The Real Top Gun

Nobody handled a Tomcat like Snort. *by Debbie Gary*

AS THE F-14 TOMCAT ROUNDED THE FANTAIL on the aircraft carrier's port side, Dale Snodgrass whipped it into an 85-degree banked turn. With its right wingtip below the flight deck, the jet sliced past the spectators, rolled wings level and pulled up into the vertical S of a double Immelman, then shot back down into a high-G aerobatic performance that flung mist off the wings like fur in a catfight.



PAUL BOWEN/AIRTOAIR.NET

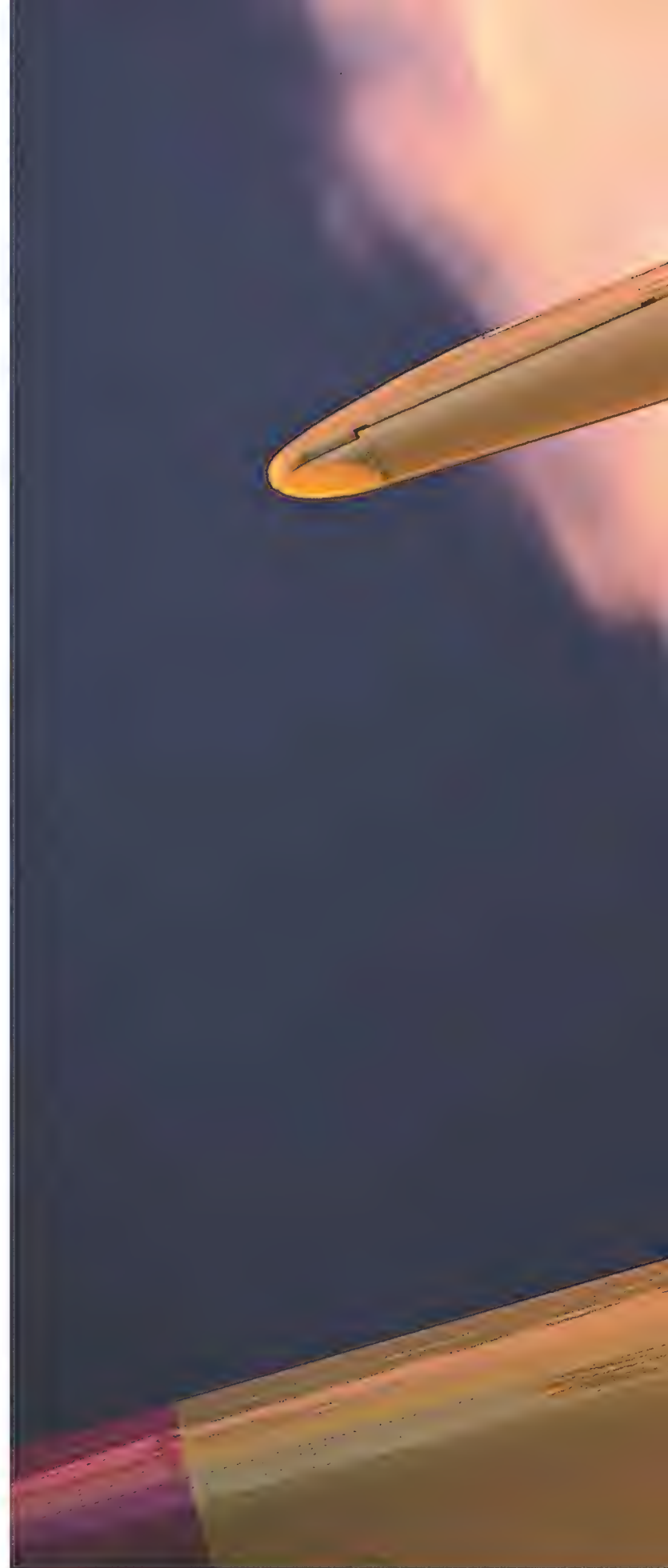


COURTESY DALE SNODGRASS

Dale Snodgrass (above, left) is known as a virtuoso of the F-14 (left, with squadron ops officer Dirk Hebert at right, in 1990).

It was the 1988 Dependents' Day Cruise for the families of the USS *America* personnel, and as he did with all demos at sea, he made that first pass and his impossibly tight turns right alongside the boat, a spitball's distance from the flight deck.

A third class petty officer caught the first pass in a snapshot. When Snodgrass saw the photo, he said, "Holy cow! Make me 50 copies and burn the negative. I don't want that to follow me." But it has, becoming one of the most passed-along photographs in airshow history. And it is classic Snodgrass: low





and close, in the right place at the right time with the talent for making an airplane pop out of the sky and into the mind's eye.

During his naval aviation career, Snodgrass, whose call sign is Snort, became the definitive F-14 pilot. He got into the airplane straight out of flight school in 1974, when the F-14 was new and no other low-time pilots had flown it. He was the first in that category to land it on a carrier, both day and night. In 1978 he attended Top Gun, the Navy Fighter Weapons School, which turns the best pilots into instructors. In 1985, he became the Navy's Fighter Pilot of the Year. The following year, the film *Top Gun* turned the viewing public into crazed F-14 fans (Snodgrass

did a little flying for it), and Grumman named him Topcat—Best F-14 Pilot of the Year. He trained so many young fighter pilots and staged so many dogfights in it that he became unbeatable. He also flew more displays over more years than any other military demo pilot. Flying the F-14 in war and in peace, he has racked up more than 4,800 hours, making him the highest-time Tomcat pilot in history.

Snodgrass loves flying airshows, and even when he became Commander Fighter Wing Atlantic, commanding all the F-14s in the Navy, he continued to find a way to fly. "I started doing the demos and I liked it so much that I stayed connected to the airshow circuit by hook and by crook from

Snodgrass' repertoire extends beyond modern jets; here, Snort flies a World War II SNJ trainer at a 1999 airshow.



US NAVY/DANIEL J. McLAIN



USAF/STAFF SGT. SHELLEY GILL

Above: Snort takes off in an F-86 at Virginia's Oceana airshow in 2004. That year, he spoke to kids at the Air National Guard Base in Jacksonville, Florida (left).

Let's see Maverick try this: Snodgrass knife-edges around the USS America, unintentionally creating perhaps the best known airshow photo in history.

1985 to 1997—12 years, which was unprecedented in military demo flying,” he says. “Everybody did two, three years.” He made 400 demonstration flights in the Navy.

In 1985 he met a group of pilots from the Kalamazoo Aviation History Museum in Michigan. The museum had acquired one of each of the piston warbirds that Grumman manufactured and named for cats—the Wildcat, the Hellcat, the Bearcat, and the twin-engine F-7F Tigercat—and flew them in an airshow act called Flight of the Grumman Cats. Snodgrass and the pilots agreed to fly together. The Navy provided the Tomcat, and Snodgrass flew with the Kalamazoo team in their second performance. It was a powerful moment for the crowd: the first time they had seen old warbirds flying in close formation with a modern jet.

The chemistry between the warbird pilots and Snodgrass was magical. His father had been a World War II marine aviator flying F4U Corsairs in the Pacific and had become a Grumman engineering test

pilot, so Snort had a special affinity for the old fighters. The Kalamazoo pilots were impressed and surprised by his flying.

Retired Navy F-4 Phantom pilot John Ellis, who led the formation, says, “The slow speeds we flew were pretty challenging for an F-14 pilot when we were maneuvering, and we expected him to fly with his wings extended forward in landing configuration...but he joined up and immediately swept his wings back.”

Flying with the wings back reduced the amount of lift they generated, and the speeds the group flew put the F-14 close to stalling at times. But Snodgrass flew with skill and finesse, and the higher power settings required in the delta-wing configuration gave him more throttle control, a critical factor in smooth formation flying.

Over the next 11 years Snodgrass became close



COURTESY DALE SNODGRASS

friends with the Kalamazoo pilots, sought advice from top civilian show pilots, flew shows with the Grumman cats whenever possible, and learned to fly piston warbirds himself. All of this led to several extraordinary things, the most memorable of which is the 1996 Flight of the Twin Engine Cats.

After Desert Storm, where Snodgrass served as a squadron commander and led 34 strikes, he and Ellis designed a sequence that included the F-14 and the Tigercat flying formation aerobatics. He then spent about 10 days practicing at the Air National Guard base in Battle Creek, Michigan, to see if and how it could be done.

Flying close magnifies the risk of collision, especially between dissimilar airplanes, so flying formation requires a great deal of trust between the pilots. The Tigercat, a sleek 1940s design, and the F-14 are so different that most pilots could not imagine the two flying formation aerobatics. During the nose and wing attitude changes of a looping or rolling maneuver, the speed and flying characteristics of each airplane change in dramatically different ways. One airplane can accelerate while the other slows up. One airplane might need massive amounts of power, while the other's throttle is nearly at idle.

Snodgrass had been thinking about it for a long time and felt sure he could do it. Ellis decided he was willing to try: "There are some pilots who seem to have a special sense of awareness of where they are at all times," he says. "Dale has that particular ability. His flying is smooth and aggressive at the same time. His senses are a little sharper than other people's. He knows when he is an inch from the ground, when he has wingtip clearance and can roll the plane into knife edge right on takeoff."

Air boss Ralph Royce describes the first time he saw them. "On the runway, you could hear the 2800s [Pratt & Whitney engines] on the Tigercat and could barely hear the jet. They came down the runway, the Tigercat humming and Snort not even in [after]burner. Ellis lifted off and kept it fast. Snort stayed under him. Then he came off the runway, sucked the gear up, and called 'Pull.' I've seen a lot of guys do a lot of things in airplanes and I don't get impressed too easily, but when I saw that I said, 'Ho boy, we've got something different here'.... They were clearly two consummate professionals working at the peak of their ability."

All of Snodgrass' display flying has been amazing: from the crisp, aggressive demos of the F-14 to the elegant solos in P-40s, P-51s, T-6s, and boomerang-winged F-86s. His new formation act makes the retro beauty of the MS-760 Paris Jets sexy again. But nothing compares to the Flight of the Twin Engine Cats. It also gave birth to the

Navy's Legacy Flights and the Air Force's Heritage program, both of which pair old and new fighters at airshows.

In spite of his remarkable flying skills, and his ability to manipulate the rules to do extraordinary things, Snodgrass, like all junior officers flying red-hot machines, occasionally found himself in trouble for hotshot flying. Once, for example, a high-speed flyby with an aerobatic split-S to a landing got him confined to quarters for 10 days.



PAUL BOWEN/AIRTOAIR.NET

But nothing impeded his progress up through the Navy or out into the civilian airshow world, in which he has enjoyed a fully sponsored career since 1999. He has also taught advanced bush flying to pilots in Africa. And in St. Augustine, Florida, where he lives with his wife, Denise, he teaches formation flying and aerobatics to warbird owners, and provides upset training—recovering from unintentional aerobatic flight—for corporate pilots and MS-760 Paris Jet customers.

Meanwhile, more than two decades later, the famous photograph has taken on a life of its own, showing up all over cyberspace. When I showed it to the man behind the Starbucks counter pouring espresso shots into my latte, he already knew it. "Oh yeah," he said. "That's the Top Gun guy." —

Flying an F4U Corsair, Snodgrass turns it out at the 2002 Sun 'n Fun airshow in Lakeland, Florida.

Century Series Wannabe

North American F-107A | BY STEPHAN WILKINSON

DEPENDING ON WHO'S TALKING, the North American F-107A was either the best fighter the Air Force didn't have the sense to buy, or a politically flawed loser from the outset.

The F-107A will be remembered forever, if it is remembered at all, for being configured as no jet had been before or since: the sharp-edged maw of its air

nuclear bombers, whether they were strategic go-liaths or small tactical fighter-bombers. So rather than a bomb bay, the -107 had a kind of belly pouch that could half-cradle a hydrogen bomb to drop at Mach 2 from altitude or deliver from an under-the-radar approach.

That's why the intake was piggyback. A conventional nose inlet would have required an internal air duct that would interfere with the centerline weapons station. Wing-root intakes that bracketed the bomb might have worked, but North American thought the dorsal tunnel straight back to the engine was a neater solution. (Some have claimed that wind tunnel tests showed airflow around a nose intake would interfere with bomb release, but no such testing was ever done on an F-107A.)

The -107A's inlet ducting had panels that automatically choked off or opened the inlet to allow the proper amount of air to the engine at everything from double-supersonic to runway-approach speeds. The fighter-bomber lacked conventional flight control surfaces: Roll was controlled by spoilers rather than ailerons, an all-moving vertical fin instead of a separate stabilizer and rudder worked yaw, and the horizontal stabilizer for pitch control was also an all-moving unit.

In his 2002 book, *North American F-107A*, William J. Simone recounts one of the hairiest F-107A flights, which was made outside the testing program. Air Force Major Clyde Good delivered the number-two airplane to the Air Force museum in Dayton, Ohio, in November 1957. Good's -107A, by then almost ready for the scrap yard, had no navigation radios, so he planned a day trip to follow an F-100 Super Sabre from Edwards Air Force Base in California to Wright-Patterson Air Force Base, where the museum is located.

Problems at a refueling stop en route resulted in Good becoming separated from his lead, and after following highways as far as St. Louis, he ended up in the dark, atop an undercast. He had already discovered that



Although an F-107A pilot would have had difficulty checking his six, he probably could have outrun his adversary. In 1956 tests, the aircraft reached Mach 2.

intake, feeding a prototype Pratt & Whitney YJ-75 engine, was just above and behind the cockpit, giving the otherwise sleek fighter the look of a fourth grader with an oversize backpack. In an era of dart-like Mirages and Delta Daggers, the F-107A was a single-engine-jet Winnebago.

The F-107As were built during the mid-1950s paroxysm of fighter/interceptor/fighter-bomber development that resulted in what came to be called the Century Series—all with -100 designations—which, except for the initial un-Area Ruled Convair F-102s, were the first reliably supersonic Air Force jets.

In the 1950s, every service but the Boy Scouts seemed to want nuclear-strike capability. And not only were the Air Force, Navy, and Army all competing to deliver The Bomb, within the Air Force, both Strategic and Tactical Air Commands wanted



the airplane had no cockpit or instrument lights, since it was never intended to fly at night. Nor had Good intended to fly at night, so he hadn't bothered to pack a flashlight—just a Zippo lighter that he occasionally flicked to check the instruments. He guessed at a heading from St. Louis toward Dayton, and eventually Wright-Patterson radar picked him up and vectored him down through the clouds and onto final.

Gear down, landing lights on...oh wait, no landing lights either. Good set down with one hand on

the stick and the other on his Zippo so he could monitor the approach speed.

After three F-107As were built, the development contract was canceled in favor of the Republic F-105 Thunderchief, which went on to do yeoman service in Vietnam (see "Thuds, the Ridge, and 100 Missions North," Feb./Mar. 2009). But at the time the Office of the Secretary of the Air Force made that decision, the F-105 had flown for barely nine hours and had already exhibited, in the words of Air Force test pilot Mel Apt, "more deficiencies than are normally encountered in other aircraft at a similar stage of development." The F-105 had an internal bomb bay, however, which Tactical Air Command loved—it wasn't sort of a bomber, it *was* a bomber—and the Air Force wanted to find work for slumping Republic, while North American already had the F-100 and follow-on F-86 programs to keep it busy.

With one F-107A safely ensconced in the Air Force museum, the other two served in the late 1950s with the National Advisory Committee for Aeronautics (later NASA). Today only one remains, at the Pima Air and Space Museum, in Tucson, Arizona. ✈

Two F-107As became NASA high-speed test aircraft. Number 55120 (above) was badly damaged in September 1959 when Scott Crossfield had control malfunctions. Number 55118 (left) was laid to rest at the Pima Air and Space Museum in Arizona, which abuts the Davis-Monthan Air Force Base storage facility.



TOP: NASA DRYDEN FRC; LEFT: WERNER HORVATH

A high-angle, close-up photograph of an F-15C fighter jet in flight. The aircraft is angled upwards and to the right, with its wings and fuselage clearly visible. The background is a vast, arid desert landscape under a hazy sky. The lighting is bright, casting shadows on the aircraft's surfaces.

THE LAST GUNSLINGER

THE F-15C IS THE ONLY DEDICATED DOGFIGHTER LEFT IN THE U.S. MILITARY FLEET. WHY ISN'T THE AIR FORCE REPLACING IT? BY MICHAEL BEHAR

Over its 35-year career, the F-15C (here on a training mission over the Pacific Ocean) remains the air combat champ, with 104 victories and no losses.



WHILE DRIVING THROUGH DOWNTOWN Mountain Home, Idaho, on a gray February morning, I notice something troubling: Mountain Home has no mountains. Later I learn why. In the 1880s, the town was relocated. Its original site was an Overton trail stage-coach stop called Rattlesnake Station. A post office, a farmhouse, and a few clapboard structures were nestled in the foothills of the Sawtooth Range, where snowy peaks soar above 10,000 feet. The outpost served a gunslinging clientele of trappers, miners, and explorers, and, true to the romance of the American west, survival there required a will and an ability to fight. But in 1883, the Oregon Short Line railroad laid tracks seven miles southeast, on the Snake River Plateau. A more comfortable life beckoned, so the town moved. And that's when Mountain Home lost its soul.

Its rebirth began in August 1943, when the U.S. Army Air Forces built an airfield on the outskirts of town to train B-24 Liberator crews. Soon the base expanded, until it encompassed 134,000 acres. In 1991, the F-15 Eagles arrived. Built by McDonnell Douglas (now Boeing), the F-15 made its first flight on July 27, 1972, and the C model remains the only fighter in the U.S. arsenal designed exclusively for air-to-air combat. Its pilots have restored to Mountain Home the sensibility of the gunslinger, whose singular pursuit leaves no safety net: It's kill or be killed.

But after more than 30 years in service, the F-15 dogfighters are becoming an endangered species. To blame are the multi-role, fifth generation Lockheed Martin F-22 Raptor and F-35 Lightning II. By 2025, the ambidextrous multi-roles, along with unmanned aerial vehicles (UAVs), will have replaced all F-15Cs, a drawdown that's already under way. Some F-15Cs are headed to the Air National Guard; others are being cannibalized for parts. A handful of pilots will get reassigned to the F-22, but an unlucky few might end up holding the joystick controlling a UAV, or grounded at desk jobs.

For their part, Department of Defense wonks claim that America's enemies reside in caves, unreachable by aircraft. F-15C pilots see it differently. The threat of an airborne attack has diminished, they say, precisely *because* the Eagle has maintained air dominance over the battlefield for nearly four decades. "We are a victim of our own success," says Lieutenant Colonel Mark McGeorge, who is chief of flying operations and training at Air Combat Command at Langley Air Force Base in Hampton, Virginia, and has 2,800 hours in F-15s. "If we don't maintain our advantage of air superiority, then maybe our enemies will decide to challenge our aircraft directly."

"THERE ARE JUST NOT GOING to be enough airplanes anymore," declares 42-year-old Lieutenant Colonel Jim Stratton. A Chicago native, Stratton is the commander of Mountain Home's 390th Fighter Squadron, one of four under the 366th Fighter Wing. "We're taking on more risk because some elements within the DOD assume that air superiority is going to be a given." Stratton has flown combat mis-



USAF/STAFF SGT JOSHUA J. GARCIA

F-15Cs require 11 hours of maintenance (above) for every hour of flight. Mountain Home's F-15C pilots often train beside F-15E Strike Eagles. "At the end of the day," says Lieutenant Colonel Jim Stratton, "we're all better off."

sions in Kosovo and Iraq. To his dismay, his entire squadron—21 F-15Cs and 13 fighter pilots—will be disbanded by September.

Now you'd think the Eagle top guns—the pilots refer to each other as "Bros"—would be hankering to get behind the stick of an F-22 (and eventually an F-35, due in 2016), with all its "Gucci" technology, as 29-year-old Captain Benjamin Leestma puts it. But they're not. "The thing is, [in multi-role fighters] there is so much information that you have to weed through to get to what you really care about," says Leestma, Mountain Home's chief of weapons and tactics. Pilots like Leestma joined the Air Force to



fly the legendary F-15Cs. “I have spent six years working my tail off to get to the point where I am,” he says. “The jet is a twin-tail, twin-engine, combat-proven, air-dominant fighter. Being single-seat allows me to make and execute instant decisions without coordinating with another crew member. In my experience, the speed at which the pilot can make and execute decisions is often the key to success in air-to-air combat.” Leestma concedes that the F-22 and F-35 are indeed be-all, do-all workhorses, but complains that the pilots flying them rely too much on gadgetry and too little on grit. The Bros are a vanishing breed, bemoans another Eagle pilot. And they warn that mothballing F-15s while not pursuing a fifth generation air superiority jet—one designed principally for dogfighting—is a mistake, a risk to America’s national security.

The news is not all bad. Sweeping technological upgrades since its inception have rendered the F-15C a formidable 21st century weapon, while additional add-ons in the near-term will prolong its

viability. What upsets the F-15C pilots at Mountain Home is that in the interim the Air Force will begin curtailing the Eagle’s mission as a dogfighter. If, by chance, the country goes to war where air dominance is contested, the multi-role platforms will supposedly handle dogfights just fine. But new recruits to the multi-role programs won’t spend long hours flying dogfight scenarios. Stick time is limited—operating an F-22 costs \$50,800 an hour, compared to \$31,800 for an Eagle—and there are just too many

other systems, procedures, and missions to master.

The fifth generation assumption is that pilots will eliminate the enemy before having to engage at close range. “At the end of the day, if you are dogfighting in an F-22, lots of mistakes happened in the previous 80 miles,” says Stratton. But mistakes *do* happen. Stratton also worries that those who fly the multi-roles aren’t hardwired for air-to-air combat. Of his F-15C Bros, he says, “We attract a certain portion of the population to the job, guys



USAF/MSGT MICHAEL AMMONS

The F-15C (left, firing an AIM-7 Sparrow missile during training) scored 34 of Desert Storm’s 37 air-to-air victories; F-15Es (below, being loaded with weapons at Mountain Home) pounded Iraqi Scud missile sites.



USAF/MSGT KEVIN GRUENWALD



USAF/AIRMAN 1ST CLASS DEBBIE LOCKHART

who bring that controlled aggression and cunning and desire to never lose, no matter what the odds are.”

LAST YEAR I WENT TO CUBA and for two weeks drove 1,100 miles around the island. No doubt you’ve seen photos of the vintage 1957 Chevys there, those pre-Castro leftovers that roam the countryside in mint condition, engines purring, as if they’re fresh off the lot. I had a chance to inspect one of these stalwart gems up close. Its owner showed me how he had retrofitted his with a diesel motor from a Mercedes-Benz, and installed air conditioning and a thumping audio system. Surely Chevy’s engineers never envisioned the kinds of modifications that have kept this classic alive in Cuba for a

half-century. But its sturdy frame, modular architecture, and generous engine compartment left ample room for modernization. The story of the '57 Chevy is the story of the F-15 Eagle.

Stratton walks me out to the Mountain Home flightline, where an icy wind scours the tarmac. F-15Cs are aligned like sentries, their wing pylons laden with air-to-air missiles. Maintenance crews scurry from airplane to airplane, checking and rechecking avionics, engine specs, hydraulics, control surfaces, and weapons systems.

We approach Stratton's F-15C where a fresh-faced kid has just finished hand-polishing the landing gear assembly. He sees us coming, jumps to his feet, and acknowledges Stratton, his commanding officer. I follow Stratton up an aluminum technician's ladder. He slides into the cockpit while I stand on the ladder's top rung. "Don't touch anything," he warns. "You could arm the weapons system."

The dials and knobs are decrepit; nearly every painted surface is scuffed and chipped. The control stick looks like it might have been dragged behind a tractor for 60 miles. And I'm pretty sure that the tattered pilot's seat came from the VW bus of a group of Deadheads, shortly after the '77 spring tour. To discover where the magic happens, I have to peek beneath the forlorn facade. Integrated into both the interior and the exterior fuselage are several large compartments and caches. They once housed hefty pneumatic controls and bloated radar and weapons components that pre-dated the microcomputer revolution. But as technology shrank, the F-15's flight systems got smaller and lighter, leaving room to cram in new innovations. Instead of languishing as decades passed, the Eagle got more agile and lethal.

By the 1980s, McDonnell Douglas engineers had gained enough space in the forward fuselage to add a second seat for the F-15E model, a potent air-to-ground

strike fighter. It boasts under-wing fuel tanks to extend its range, a digital flight control system, low-altitude "tree-top" navigation, infrared night vision, and color cockpit displays. During Operation Desert Storm, F-15Es pounded Iraqi Scud missile sites, obliterated Saddam Hussein's feeble air force, and rained cluster bombs on his Republican Guard troops.

To detail the dozens of improvements since the Eagle's debut—communications, navigation, propulsion, displays and instruments, electronic warfare, sensors, and weapons targeting—would drown you in acronyms. The list of upgrades that stokes F-15C pilots, however, is much shorter. Stratton has two fa-



USAF/SSGT SUZANNE M. JENKINS



F-15Es will remain at Mountain Home (above, refueling over Iraq), but F-15Cs will soon transfer to Air National Guard units. Right: Colonel John Bird, from Mountain Home, arrives at Nellis Air Force Base, Nevada, for a training exercise.



USAF/AIRMAN 1ST CLASS DEBBIE LOCKHART

vorites. The first is the Fighter Data Link, or "Fiddle." In essence, Fiddle gathers flight data from other Fiddle-equipped aircraft and sews it into a single seamless display. In combination with other technology, Fiddle also collects information from airborne refueling tankers, E-3 airborne warning and control systems, and forces on the ground or at sea, even sub-

marines. "It gives you a three-dimensional picture of the battlespace from a God's-eye view," says Stratton. "As a flight lead managing four airplanes and sometimes up to 14, I used to have to put what all the guys were telling me in my ear into this three-dimensional picture in my head. Now that is all presented to me graphically on my Fiddle display."



During a 2009 training exercise over Montana, F-15Cs release flares and execute evasive maneuvers.

halted at 187 jets and slashed further funding. The ongoing F-35 development program, a relative bargain at \$155 million per airplane, is already over budget and behind schedule, causing Congressional colic. Cutbacks to its \$300 billion-plus program are virtually certain. That's just fine with F-15C pilots, who believe their dogfighters are plenty capable of defending America's turf for the foreseeable future. "The F-15C is still our front-line air superiority fighter," says Major John Boehm, a veteran F-15C pilot and program element monitor at Langley, whose job entails setting future hardware and software requirements for the Eagle fleet. "It was overbuilt in a good way, designed with enough extra margins to allow us to have all the options we have today for upgrading. Some call it the world's greatest fighter based on its proven legacy. It has a kill ratio of 104-0."

In a dogfight where an F-15C might face off against a Russian Sukhoi Su-27 or China's Shenyang J-11, both fourth generation fighters, or even the mighty fifth generation F-22, Eagle pilots are confident they'd triumph. In fact, two pilots told me that if an F-22 uses its thrust vectoring to do a post-stall maneuver during a dogfight, there is a specific move that they can execute to win. This classified tactic is the F-15C pilot's ace in the hole. Stratton acknowledges the tactic, but cautions that in air-to-air combat, no one move will always solve a particular problem. "Rather, it is much more likely that the F-15 pilot was able to fly his aircraft to its maximum potential [while] the F-22 pilot made a maneuver error. While the machine is important, and the F-22 enjoys a maneuvering envelope advantage over almost every aircraft, the man in the cockpit tilts the balance between success and failure. A pilot that is flying his F-15C to its maximum potential is a very tough adversary to defeat."

A number of features make the F-15C an ideal dogfighter. With a thrust-to-weight ratio greater than 1:1, it is one of the few fighters with that power advantage, so it can accelerate during a vertical climb. And the large lifting surface of the fuselage enables the Eagle to keep fly-

Another prized advance is the Joint Helmet Mounted Cueing System. "We just call it The Helmet, with the emphasis on *the*," says Stratton. From his gear locker in the ready room, Stratton offers me his helmet to inspect. The visor is nearly opaque, and the shell is embedded with magnetic sensors that transmit real-time spatial data from a pilot's head position to receivers inside the cockpit. During a dogfight, Stratton can cue and fire weapons at attacking aircraft, even during high-G maneuvers, simply by glancing at his enemy. "I really don't know how we did missions before we had the helmet," he admits.

Leestma, who has racked up more than 900 F-15C hours, tells me about a recent radar makeover called Active Electronically Scanned Array, or AESA. (As part of an Air Force F-15 program known as Golden Eagle, C-model airframes are undergoing stress tests, and those with the least wear and tear will receive an AESA

system.) Conventional radars make sweeps that show solid objects as pings or blips on a head-up display. With each radar pass, the process repeats. The problem is that in a dynamic air-to-air situation, bad things can happen between cycles. "By the time the radar we have now does all its math, you might have something completely different out there," says Leestma. AESA is fluid and encompassing. It uses multiple frequencies to continuously scan the skies, then stitches together a real-time radar image. Leestma explains, "It paints the picture of anything moving out in front of you and constantly updates it."

THE ECONOMY IS QUASHING spendy military ventures, and fifth generation fighters are already suffering the wrath of the red pen. With every F-22 costing as much as \$227 million, according to the Rand Project Air Force analytical team, President Obama ordered production

TED CARLSON/FOTODYNAMICS.COM

ing even with a lot of battle damage.

The Eagle also blends a computerized system with old-fashioned manual controls. Other fighters, particularly the F-22, are pure fly-by-wire. In the F-15C, say its pilots, a pilot can override his computer warnings and go beyond the edge to get that little bit of boost to survive. In the F-22, the computer system simply won't allow that, as it thinks the airplane will break up in flight—not good when you're in the midst of a dogfight and need to execute tactical maneuvers.

Major David Skalicky, leader of the F-22 Aerial Demonstration Team, and a former F-15C pilot, disputes the F-15C pilots' claim of an advantage. "The F-22 will aerodynamically out-perform and out-power the F-15 in every scenario," says Skalicky. "That isn't to say that on exceptionally rare occasions, F-22 pilots haven't lost to F-15 pilots in practice dogfights due to poor maneuver selection. However, the credit for victory in that scenario belongs to the F-15 pilot, not the airframe."

THE MAJORITY OF active-duty Eagle pilots flying today were born after the aircraft went into service. So to find out if anyone expected the F-15 to remain a viable dogfighter for more than a quarter-century, I tracked down those who designed and built it. They gather every three years for a reunion on the anniversary of the F-15's inaugural flight. Donn Byrnes, who flew F-86 Sabres and F-84 Thunderjets in the 1950s and later spent six years on the Air Force side of the team designing and developing the SR-71 Blackbird, was the system program office project manager for the F-15 airframe. He got involved with the Eagle program in 1969, coordinating with McDonnell Douglas engineers during the early blueprint stages, and stayed through mid-1975.

The 78-year-old retired colonel is panting when I reach him by telephone at his home in Los Lunas, New Mexico. "Sorry, I just hauled in a cord of firewood," explains Byrnes, who wrote the book *Air Superiority Blue*, a retelling of the Eagle's birth. I ask Byrnes what spawned the sudden demand for an air superiority fighter, something the Air Force hadn't shown an interest in since it procured the P-51 Mustang in 1940. "We had our tail feath-



USAF/STFF SGT. MICHAEL B. KELLER

ers burned off in Vietnam by the MiG-19, and if we went to war with Russia, we would be in deep trouble," he says. "So we wanted to put together a machine that when fitted with a skillful pilot, who is aggressive and courageous, would have the ability to turn and burn and kill whatever he comes across."

Byrnes agrees with most Eagle pilots that the F-15's longevity is a direct result of its singular mission. "We designed the F-15 to do what we wanted it to do, and nothing else." Byrnes is a critic of the multi-role concept: "You don't want to make an airplane be the Swiss Army knife of a fighter," he says. "I'm absolutely not in love with the idea. The F-35 is the worst nightmare of hardware idiocy. It does everything wrong. You need a long-legged

The Air Force calls the F-22 an air dominance fighter, but some pilots worry that the airplane's extensive computer systems can lead aviators to become too reliant upon its technology.

fighter, not a short, fat one."

Byrnes credits chief Air Force engineer Frederick Rall, now deceased, for championing the F-15's robust and redundant design. "His mantra was: The first failure can't kill you, and that the only failure we could define that you could not recover from was the stick busting off in the cockpit." Consider the story of Israeli F-15 pilot Zivi Nedivi, who during a training exercise in 1983 hit and destroyed an A-4 Skyhawk. The collision sheared off all but two feet of Nedivi's right wing. He



punched the afterburners to generate lift over the fuselage and managed to land.

The Air Force purchased its last F-15 in 2001, and the 499 Eagles that remain in the fleet (C, D, and E models) are, on average, 20 years old. Meanwhile, foreign sales, mainly to Singapore and South Korea, could keep manufacturing plants at Boeing chugging along for at least another few years. “Given the end of the F-22 program, if force structure begins to look really bad, the Air Force could buy a few more F-15s,” says Richard Aboulafia, vice president of the Teal Group, a military consulting firm in Fairfax, Virginia. “Every day the line stays open, it keeps alive that chance.” A new prototype, the F-15 Silent Eagle, has a stealthy, radar-absorbent coating. “Singapore and South Korea are getting planes that are extremely capable, with the latest systems and sensors,” says Aboulafia.

For a guy integral to the design of the world’s greatest fighter jet, you’d think Byrnes might be a bit wistful to see the F-15 destined for the boneyard. He’s not. In fact, he’s dismayed that the Air Force never acquired a fifth generation dog-fighter. “It’s the only fighter in modern times that has been in constant production for 35 years—who would have thought—and I think it’s because we didn’t have our act together to buy an-

other one,” he says. “When you kick pilots out in the dark and say to them, ‘Go find what that is and kill it,’ riding an old horse is not the way to succeed. You are asking them to take an airplane guaranteed for 4,000 flight hours with airframes that already have about 6,000—way past their approved fatigue life—and then rat race with them.”

Very few Eagle pilots think the F-22 or F-35 will eliminate the need for a dedicated air superiority fighter with a skilled pilot. If you’re a multi-role pilot, “intel hands you a target package, you fly the black line, drop the bomb, and come back,” says Stratton. “Multi-roles can do different missions, but their primary mission—the reason we bought them—is to drop bombs. A guy that is going to go drop a bomb has been given a discrete target.

There is no decision-making. In the F-15C, we’re told to protect a battlespace. It’s a much more fluid environment.”

UAVs, such as Predator drones and their offspring, which undoubtedly will be more sophisticated, could take on dogfights in the future. In fact, some experts predict the F-35 will be the last manned fighter ever built. This deeply troubles F-15C pilots, who know that once their Eagles are scrapped, they could get reassigned to UAV duty. Imagine training to race a Formula One speedster, only to be told that you’ll be touring the track in a Prius. “I’d shoot myself,” says Leestma. “[Flying UAVs] is a totally different mindset. My skills are not transferable. I am putting myself in a position where my pink body is on the line. I’ve gotta kill a guy before he kills me.... Personally I don’t think there is a re-

F-15Cs of the 1st Fighter Wing, at Langley Air Force Base, are readied for a training exercise, below. With careful inspections (exhaust nozzles, right) and Golden Eagle upgrades, some F-15Cs will remain in service through 2025.




USAF/STAFF SGT COLETTE BENNETT



USAF/ATC DELICHA E. GERMANY

placement for [a pilot who would] actually make that decision to hit the pickle button and shoot somebody.”

LISTENING TO LEESTMA, I can’t help recalling what happened when the Oregon Short Line arrived in Idaho. Survival no longer hinged on tenacity and resolve. The multi-role jets might herald the future of warfare, with their big bag of tricks to defend the skies. But in both culture and cunning, the dogfighters are the descendants of the gunslingers at Rattlesnake Station, who never went anywhere without their six-shooters, and at high noon, knew how to kill with terrifying precision. 

Tribute to an Aviation Journalist

**IF YOU READ
AIRPLANE
MAGAZINES,
YOU'VE SEEN
HOWARD LEVY'S
PHOTOGRAPHS.**



The photographer and his clientele, ca. 1980. One of his early photos is of the 1937 M-156 flying boat, which Glenn Martin offered to Pan American World Airways. Instead, Aeroflot took one – the only one.

HOWARD LEVY TOOK his first photograph in 1936, when he was 15 years old. His subject was his sister...and an airplane. From that moment on, Levy built an exuberant career around his favorite pastime, which he called “chasing aircraft.”

When Levy died last January, at 88, he was one of the most accomplished aviation photographers in history. His photos appeared in *Look*—where he was an assistant editor for 25 years—and most aviation magazines, including *Air & Space*. When picture editor Caroline Sheen began to work with him last fall on this retrospective, he was assembling a feature for a British magazine—a photographic history of aircraft designed by Burt Rutan.

Levy received a Lifetime Achievement Award from the International Society for

Aviation Photography in 2003, and was a founding member of the American Aviation Historical Society.

When a career is this full, how does one choose the highlights? Levy struggled. He e-mailed last fall, “I am in a real big quandary.” He proceeded to list the types, eras, circumstances, locations, and in some cases histories of the thousands upon thousands of airplanes he had photographed. Should he include the photos from his 30-month trip around the world as a U.S. Army Air Forces photographer during World War II, when he shot military aircraft in Egypt, Tunisia, Sicily, Italy, India, and Bengal? “I photo’d military and civilian Grummans from the ’30s to post-WW II days at their Long Island factories, which began in a Quonset hut at Sever-

sky Field,” he wrote. “I also photo’d a number of the industry pioneers. In fact, I photo’d a WW II US, British, French, and German ace together but I can’t remember who each was.” He had hundreds of prints from visits to airports, museums, and factories, and from the Paris Air Show, which he attended every two years from 1951 to 1981. “So you can imagine the amount of pix I have,” wrote Levy. “Any suggestions what might be of particular interest?”

His friend Glenn Stott, who met him at meetings of Experimental Aviation Association Chapter 315, where Levy had been a member for years, says Levy never missed the Sunday gathering at Old Bridge Airport, near the photographer’s New Jersey home. Stott, a former Royal Canadian Air Force pilot, often looked



A WACO UEC at New York's Floyd Bennett Field caught Levy's eye in 1936. He was taking a photograph of his sister, but it's the airplane that launched his career.



Frank Piasecki with his first helicopter, the PV-2.

through Levy's photo collection. "You just mention an airplane, and he could talk to you for 20 minutes about it—the background of the people who built it and the company that started it that then became this company." Stott says that Levy intended to donate the collection to a university, where it could be cataloged and preserved.

In the 19 years that EAA media director Dick Knapinski has been with the Wisconsin-based association, he doesn't remember an Oshkosh fly-in without Levy. "And you could tell he was in his

natural habitat," says Knapinski.

Levy finally settled on the photographs he wanted published in *Air & Space*, and he wrote this introduction for them:

"Now, here are a few photographs of the many individual company-built aircraft that this photographer has met up with in much earlier days and which possibly not too many of the readers may know of unless they are historians."

And as for his earlier question, "Any suggestions what might be of particular interest?" All of them, Howard.

—The editors

[Below] The signature purity of Levy's photographs captures an airplane's soul. The RS-1, a humble two-seater offered just before World War II began, won few customers for the New York-based Ross Aircraft Corporation but has been called "an airplane at its simplest."

[Opposite] Jack Northrop wasn't the only U.S. designer creating tailless aircraft in the 1930s. Levy caught a rare type at Floyd Bennett Field in 1938. Rebuilt by Tuscar Metals after a crash, the H-71 had rudders mounted outboard on the wings.





[Above] Levy snapped this photo of Jimmy Doolittle in the cockpit of a North American B-25 on October 20, 1943, when the general visited the 12th Bomb Group, a B-25 outfit, in Gerbini, Sicily.

[Top] A long-time member of the Experimental Aircraft Association, Levy paid as much attention to the one-of-a-kind homebuilts, like the Ra-son Warrior with its glass-enclosed cockpit and wide-chord wing, as he did to airplanes rolling off a production line. The un-warrior-like Warrior was the third airplane created by Alvis Johns, who, noted a 1958 issue of *Sport Aviation*, was 21 when he built his first airplane.

[Right] Drago Jovanovich started a helicopter company with engineers he lured from Frank Piasecki's operation. An early product was the JOV-3.



[Center] Built for Romanian aerobatic star Alex Papana, the Bellanca tri-motor competed in cross-country races.



[Below] Levy's caption for the Gwinn Aircar shows how connected he was to the activity swirling around Floyd Bennett Field, where this photo was made, in the late 1930s. "Designed by Joseph Gwinn Jr., who was Consolidated Aircraft's chief engineer when the company was based at Buffalo. [Race pilot] Frank Hawks was demonstrating the airplane around the country, and the day after our photography he flew the aircraft to upstate N.Y. Unfortunately, while conducting a demo flight and with a potential customer aboard, the aircraft tangled with unseen high tension wires, crashed and burned, killing both." After the accident, Gwinn shut down the plant.





GLENN STOTT

[Above] Of this Messerschmitt in Levy's World War II photo collection, he says simply: "Well-strafed Me 109F at Gerbini, Sicily on August 31, 1943."

[Top] Although Levy liked to go off the beaten path to chase aircraft, he also covered main events, like the roll-out of Canada's pride and joy, the Mach 2, delta-wing Avro CF-105 Arrow. He found number 201 away from the crowds at Avro's Toronto airport factory in October 1957. The Canadian government cancelled the fighter program in 1959, after six aircraft had been built.

[Above] The familiar camera around his neck and camera bag across his shoulder, Levy collected a few more photos last October at an open house and fly-in at the Eagles Nest Airport in New Jersey. He had become a fixture at the EAA airplane celebration in Oshkosh, one of the people you looked for every year.



Climate Control

IRVING LANGMUIR TRIED TO CHANGE THE WORLD ONE STORM AT A TIME.



THREE YEARS AFTER the brutal 2005 season that brought Katrina and other storms, the U.S. Department of Homeland Security began studying how to quell hurricanes. Some of the ideas it looked at, like seeding hurricanes, are conventional. Some, like dyeing hurricanes with soot, are a little out there. Since the middle of the last century, the government has spent millions of dollars on weather modification—and the only thing the scientists really had to show for it was some wild stories. Indeed, Homeland Security would be wise to revisit the efforts of a Nobel Prize winner who once sought to tame the weather.

BY SAM KEAN



On the morning of October 13, 1947, a Boeing B-17 loaded with 180 pounds of crushed dry ice took off from MacDill Field in Tampa, Florida. Two days earlier a hurricane had wreaked havoc in Miami, but had since been treading water 350 miles off Jacksonville, where it seemed ready to wind down. The U.S. Air Force B-17 rendezvoused with the storm and climbed 500 feet above its dark upper clouds, where the crew sprinkled it with a few thousand white peas of dry ice (frozen carbon dioxide). The airplane circled for a while, then turned for home. For reasons as obscure as they were controversial, the hurricane followed.

The storm, which had been drifting to the northeast, executed a full pivot, as if tracing a “7” from the bottom up. Gathering momentum, it barreled toward the Atlantic coast and slammed ashore near Savannah, Georgia, where it chewed up terrain for miles inland, causing \$23 mil-

lion in damage (\$220 million today) and killing a few people. Pretty soon, reports about the B-17’s actions began circulating in southern newspapers. The military denied that the experiment had diverted the storm, but commanders refused to release flight details and scientific data. Furious locals threatened lawsuits, and denounced the shadowy mission as a “low Yankee trick.”

Meanwhile, safe in his lab in upstate New York, the Yankee in question, Irving Langmuir, analyzed the storm data with grim satisfaction, sympathizing with Savannah but confident he’d proved that humans could, at last, control the weather.

Irving Langmuir (in glasses) and Bernard Vonnegut watch as Vincent Schaefer tries to create precipitation by exhaling into a General Electric freezer. Opposite: A cloud seeded by Langmuir’s team splits in the middle.

Until that October day, Langmuir could only call himself one of the great chemists of the 20th century. He had won the 1932 Nobel Prize in chemistry, and his contributions to the General Electric research lab—a better incandescent lightbulb among them—helped the company become one of the richest in U.S. history.

But Langmuir aspired to more than better light bulbs. He came to weather modification in his 60s, but suddenly saw a chance to end the capricious rule of weather over our food supply and to rob nature of its ruinous power. In a 1948 *Fortune* magazine article, he boasted, “There is a reasonable probability that in one or two years man will be able to abolish most damage effects from hurricanes.” Previous projects to alter the weather had been dominated by kooks and pseudo-science, but Langmuir had clout and charisma, and he persuaded GE, the U.S. Army Signal Corps, and the Office of Naval Research to collaborate on Project Cirrus just after World War II. The hurricane that turned on Savannah was Cirrus’ first big test.

The project began inside a \$240 GE home freezer. In 1946 Langmuir and a GE machinist, Vincent Schaefer, rigged an open-top freezer to mimic the cold upper atmosphere, in which they hoped to create precipitation. They lined the freezer with black velvet to make any precipitation easier to see. Icicles thick as carrots lined the top rim. To form “snow,” Schaefer exhaled a breath (which is largely water vapor) into the chamber.

At first, Schaefer and Langmuir struggled to create realistic precipitation. Water normally freezes at 32 degrees Fahrenheit, but it can also persist in a stubborn supercooled vapor state, invisibly suspended in the air, at below-zero temperatures. Progress was stalled until a roasting July day. The heat prevented the freezer from cooling properly; to lower the temperature Schaefer went to a nearby lab and borrowed a block of carbon dioxide, which freezes at -109.3 degrees. When he lowered it into the chamber, he watched with amazement as a bluish fog appeared. The temperature had finally dropped enough to drag the vapor out of suspension. When Schaefer huffed this time, ice formed instantly, thousands of tiny droplets that glistened on the black velvet like di-

amonds on a jeweler's cloth. Clouds in the sky are also suspended water molecules, and the molecules fall as precipitation only if the water coalesces into heavy drops or ice. The freezer experiment seemed to illustrate an easy way to accelerate the process.

Not long after, a second breakthrough took place. Dry ice has limitations: It has to be dispensed in small, careful doses, lest it "choke" clouds of vapor and prevent ice from forming. So another assistant, Bernard Vonnegut (older brother of writer Kurt), created ice with silver iodide. Silver iodide crystals have the same hexagonal structure as ice and can trick water molecules into latching on. Though purified silver iodide was more effective than crushed dry ice for generating precipitation, it was harder to make.

After these breakthroughs, Langmuir's colleagues threw themselves into more experiments. Duncan Blanchard, a GE assistant scientist in the late 1940s, remembers each personality distinctly. Langmuir, ever dapper in his suits, was the driving force, he says. The mechanical genius was Schaefer, a high school dropout. Schaefer, among others, jokingly referred to Langmuir as "Boss" behind his

back—"Where's Boss? Boss in today?"—but always as "Doctor" to his face.

Inside the lab, things were less formal. Blanchard remembers Vonnegut's dingy workspace "in complete disarray, with bits and pieces of wire, old test tubes, rubber tubing, and parts of generators covering most of the bench space and dripping off onto the floor." But all three men had one trait in common. "Langmuir, Schaefer, Vonnegut were always enthusiastic even when the project did not seem to work out," says Blanchard. "Science there was glorious entertainment."

The enthusiasm seemed warranted after the first aerial cloud seeding, in November 1946. GE rented a Fairchild 24 airplane, and during the flight, Schaefer identified a four-mile-long altostratus cloud at 14,000 feet. While passing over it, Schaefer slowly dispensed three pounds of crushed dry ice through a funnel. According to eye-

witnesses, the cloud "writhe[d] in torment," and within minutes had transformed into snow. That the snow fell just 2,000 feet before evaporating didn't prick the team's enthusiasm. Langmuir, observing from the ground, watched the cloud quake and shouted, "This is history!"

Modified Boeing B-17s (below) flew the bulk of Project Cirrus' cloud-seeding missions, with a mix of military and civilian crews, including GE's Vonnegut (at far left) and Schaefer (below, right).

A more ambitious experiment followed in December, near GE headquarters in Schenectady, New York. Schaefer seeded clouds with a bigger load of dry ice, but this time the clouds kept drifting, seemingly unperturbed. A day later, upper New York and Vermont were hit with the biggest snowstorm of the season. Scores of car accidents followed, and businesses shut down for a week. New Yorkers were peeved.

So far, the experiments seemed solid, but many meteorologists doubted the team's conclusions. Francis Reichelderfer, head of the U.S. Weather Bureau, told *Time*, "I feel quite sure that in many cases [Langmuir's] rain was due to natural causes." The bureau argued that weather systems are immensely complicated, and just because a cloud seeded one day started snowing the next doesn't mean that seeding caused it. Also, said Reichelderfer, Langmuir's men didn't seed clouds randomly, but picked "ripe" clouds that probably would have snowed (or rained) anyway.

Clearly, more experiments were needed, but after the snowstorm in Vermont and New York, GE lawyers had a con-
 ception: GE faced staggering legal liability. They insisted Langmuir secure the cooperation of the U.S. military, which was shielded from legal threats.

As much as his scientific acumen, it was Langmuir's stature and eloquence that saved Project Cirrus. "He could convince you that black was white—he had an acting voice," says Blanchard. "He had the ability to charm." Blanchard still remembers the day the Army Signal Corps dispatched a junior officer to GE to interrogate Langmuir about weather modification: "The [officer's] instructions were 'Milk him dry. Milk him dry.' We heard about that in the lab and we just laughed,"



FORT MONMOUTH (2)



says Blanchard. “A day or so later, Bernie [Vonnegut] and a friend saw this chap at lunch with Langmuir. Langmuir was carrying on an animated conversation while this person sat there with a glazed look on his face. Langmuir’s cow was far from being milked dry!”

Military cooperation gave Langmuir access to airplanes more powerful than the cropdusters GE had rented. Typically, a B-17 with a five-man crew would dump 80 pounds of dry ice each run; support aircraft followed to take readings and pictures. The crew targeted wide sheets of clouds, and used the dry ice to etch figures into them: Ls, Greek gammas (γ), and racetracks 20 miles in diameter. They were experimenting; they didn’t know what the optimal pattern would be.

The Savannah hurricane spooked the GE legal department all over again, so Langmuir headed out to arid New Mexico and began seeding clouds with silver iodide smoke. The work lasted around two years, and in announcing the results, Langmuir threw out all his normal scientific prudence. Just cents’ worth of silver iodide, he claimed, initiated dozens of rainstorms. One reportedly stretched 4,000 square miles and liberated 200 billion gallons of rainwater. “[It] could not possibly have been accounted for as the results of naturally occurring rain,” Langmuir insisted.

The scientist appeared on the cover of

Time, hailed as a literal rainmaker, and he even quit his job at GE to barnstorm the country—“Langmuir Quits Post to Pursue Rainmaking,” read the *New York Times* headline. A mesmerizing speaker, he wowed early-1950s audiences.

Sensing a quick buck, private pilots retrofit their airplanes with seeding equipment and began treating clouds in six states. But for every rancher or city water engineer eager to seed, a farmer or hotel owner raged about hail and poor sightseeing. In 1952, a U.S. senator from Michigan, Blair Moody, promised to open a Congressional inquiry because the spate of rainy weekends that Langmuir claimed to have caused was, a local newspaper wrote, “spoiling Michigan’s lucrative tourist business and ruining lots of picnics.”

If Project Cirrus was controversial among citizens, it was notorious among some meteorologists, who dismissed Langmuir’s claims as voodoo. In examining the 200-billion-gallon storm in New Mexico, Weather Bureau scientists concluded that the prior day a common warm front had

The Weather Bureau, part of the Department of Commerce, leased Douglas DC-6s and outfitted them with sensors before sending them into hurricanes (above). Right: Thomas Edison (at right) and Langmuir (center) examine vacuum tubes at the GE lab in New York.



swept in from the Gulf of Mexico, and it, not Langmuir, had created the rainfall. They also noted that no one had sued GE over the Savannah hurricane because in 1906 a hurricane had followed an identical path, taking the same mid-ocean turn and causing just as much damage on shore. Weather Bureau scientists hooted loudest of all when Langmuir argued that his airplanes were altering weather patterns as far away as Scotland.

With the Weather Bureau and Langmuir in disagreement, in 1952 Project Cirrus ended in a stalemate. GE was all too glad to extricate itself, and in 1957, Langmuir died, of complications from multiple heart attacks. But even with the chief proponent of weather modification gone, the cause attracted ambitious converts.

A few horrendous storm seasons in the mid-1950s gave them a chance to test their theories. Washington (after a bureaucratic delay) decided to launch Project Stormfury in 1962, through the Navy and the Department of Commerce. This was no casual mission. Its goal was to hunt—and kill—hurricanes, by sending pilots deep inside the storms to do battle.

FEW STORMS RATTLE an airplane like a hurricane. “There were some times when the turbulence got so bad that I thought, Damn, I maybe misjudged this one,” recalls David Turner, a former Stormfury pilot who flew DC-6s and WC-121s. “Except you’d hit a point where backing off was worse than going on.” So he usually plowed ahead.



“The turbulence is a rolling, boiling kind,” says Turner. “And we could see zippo,” just gray streaks of clouds and rain. The lack of vision intensified the sounds: “There was a roaring hammering of the rain on the airframe, a wild roar.”

And then the eye. Not all hurricane missions penetrated the eye, but pilots sure remember when they did. Some described a “Tarzan moment”: staggering forward out of a dark cave of clouds, fighting through sheets of water like a waterfall, wet and angry—then emerging into crisp brilliant air. “You can see all the way up forever, to the stars and the moon,” says Turner. “The wind drops off to zero. Sometimes it would have been such a painful transit getting in there,

A crew member filmed cloud behavior (top). During Project Cirrus, plexiglass covered the openings where the B-17s once had machine guns; dry ice was funneled down a chute on the bombers’ undersides.

I’d fly a few times around in the clear, and we’d have a cup of coffee and go to the bathroom and straighten up the airplane.” Eventually, they girded themselves and plunged back into the cloud bank.

In 1969, Turner started flying for the Florida-based Stormfury, doing seeding runs and ferrying dozens of strapped-down scientists into storm cores to gather data. Stormfury’s yearly budget, \$2 million, outpaced Cirrus’ (\$750,000 at its peak), and that didn’t include the millions spent outfitting airplanes, including Lockheed P-3 Orions, for hurricane hunting. Instead of dumping seeds through funnels, as had been done in Cirrus, some Stormfury scientists developed 130-pound bombs with fins. Others went micro, developing plas-

tic flares a few inches wide, called “candles,” that worked on a delayed fuse and streamed silver iodide for 36 seconds as they fell.

Despite fires, turbulence, and other dangers—or perhaps because of them—Stormfury scientists had a cowboy cockiness about playing with hurricanes. They chafed at government restrictions, which limited company pilots to seeding only hurricanes that had no chance of striking land. “Bureaucrats are scaredy-cats,” one anonymous Stormfury scientist growled to *Time*.

The scientists were cocky because, they believed, they had finally developed a fail-proof way to defuse hurricanes. Hurricanes can stretch for hundreds of miles, but they concentrate their fury in the eyewall, the bank of swirling clouds orbiting the eye, which in powerful storms span only a few tens of miles. The tighter the eyewall, the greater the concentration of energy, and the greater the damage when storms hit land. Stormfury scientists calculated that if they sprinkled silver iodide in a wide ring around the eye, the seeded clouds would writhe, rain, and collapse. This would disrupt the eyewall, sucking it outward by 10 or so miles, and crank down the winds that cause destruction.

Because of the scales involved, each seeding run required 10 or so airplanes to fly laps for an hour or two in the murky dark, in a counterclockwise swirl that required remarkable coordination. Hugh Willoughby, a former Stormfury scientist, says his colleagues knew exactly how many airplanes to fly and how far apart

to fly them. They knew what chemicals to dispense, how much, and when. They knew the type of signals they wanted to see on satellites and on radar. And see them they did: Early experiments clearly showed eyewalls getting wider and wind speeds falling.

But as the science got more objective and rigorous, support for seeding hurricanes unraveled. Blind experiments with non-storm clouds—where pilots would randomly tear open one of two sealed envelopes, which contained instructions to seed or only pretend to—proved that scientists on the ground could not reliably predict, based on observations alone, if clouds had been seeded. Some seeded clouds did nothing, and some unseeded ones blew up like mushroom clouds.

In light of these experiments, Stormfury faced the same troubling questions: Did eyewalls sometimes widen spontaneously, without human intervention? Meteorologists could not find enough suitable storms near Florida to examine, and in the early 1970s their work ground to a halt. When the scientists tried to revive the project a few years later, political forces worked against them. They tried to shift hurricane seeding to the Pacific Ocean, but China, Japan, and Australia said loud and clear the United States better back off.

Stormfury's *coup de grace* came in the early 1980s, when Hugh Willoughby and two other alumni wrote a demoralizing

scientific analysis. They concluded that hurricanes did form new eyewalls all the time—with or without seeding. They also showed that the amount of supercooled water in hurricanes—a necessary ingredient for seeding—was orders of magnitude smaller than scientists had assumed. All in all, then, seeding had probably not disrupted a single hurricane, and any observed decreases in wind speed were probably coincidental. In 1983, the Department of Commerce killed Project Stormfury for good.

WEATHER MODIFICATION combines two ancient dreams of humankind—flying and controlling the weather—and the hope of joining the two has never quite died. Private companies still seed clouds to bring rain, and China famously seeded Beijing skies to ensure clear weather before the 2008 Olympics. Colorado meteorologist Bill Woodley, a Stormfury veteran running the Homeland Security study, believes computer simulations will bring a new era of sophistication. “The explosive development of numerical models and computers allows us to play God, essentially,” he says, and evaluate scenarios without expensive tests. “In a year or two, we hope to weed out those hypotheses that have real merit.”

Willoughby, however, questions the ability to generate rain that falls all the

way to the ground: “Many very smart people spent tubs of money seeding clouds, but I know of no published example of an experiment where one investigator applied a given technique to achieve a statistically significant increase in precipitation and another applied the same technique in a different setting to get the same result.” He adds, “Since replication is the essence of science, one is tempted to say that it was all nonsense.”

Though most scientists remain skeptical about controlling weather, Projects Cirrus and Stormfury still made important contributions to the field of meteorology. The thousands of seeding runs helped scientists piece together how storms behave, work that has produced better forecasts and thus saved innumerable lives: Despite an exploding U.S. coastal population, the likelihood of dying from a hurricane now is 1/100th the likelihood in 1900.

Still, Irving Langmuir would be crushed to see the lowly state of weather modification today. However sophisticated it has grown since 1946, meteorology remains a passive, not active, science. Pilot David Turner remembers his own pangs on Project Stormfury's demise. “We'd spent a lot of time, and there were a lot of

airplanes involved,” he says. “It was disappointing to finally concede we couldn't really do it. The storms were so big, and we were so small.”

Langmuir's dream of controlling weather's destructive force has so far gone unfulfilled.



US NAVY/JIM BROOKS

Evolution of *the* Space Shuttle

HOW 30 YEARS CHANGED THE WORLD'S MOST COMPLEX FLYING MACHINE. BY MICHAEL KLESIOUS

THE SPACE SHUTTLE'S FIRST FLIGHT, a two-day mission launched on April 28, 1981, with commander John Young and pilot Robert Crippen, was an announced test flight. So complicated was the shuttle system, it could be argued, that every mission since then has been a test. Over the years, NASA fine-tuned the system with modifications large and small. As the program's end nears, the knowledge gained over 30 years will be flying on its 134th flight.

Reusable Solid Rocket Boosters

●●● After STS-5 (November 1982), the casing was made .002 to .004 inch thinner, reducing the weight of each booster by 4,000 pounds.

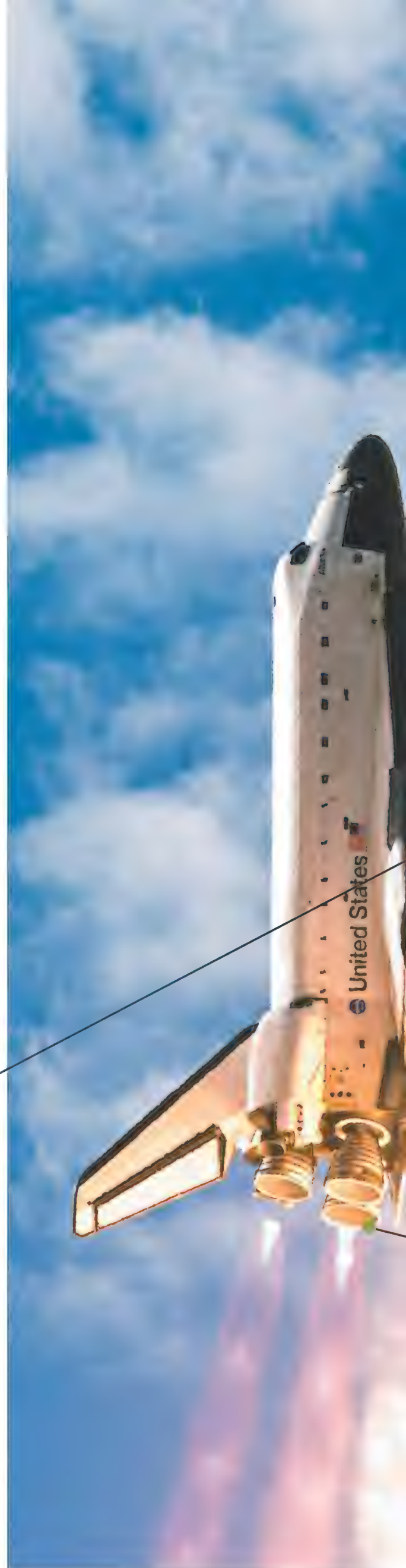
●●● After STS-7 (June 1983), engineers narrowed the booster's throat and enlarged its nozzle. The changes increased thrust, enabling the shuttle to carry 3,000 more pounds of payload.

●●● During the days leading up to the launch of *Challenger* on STS-51-L (January 1986), freezing temperatures weakened an O-ring seal in a joint between two segments of the right booster. The weakness allowed hot gases to burn through the casing, causing the shuttle to break apart on ascent, which killed the seven-member crew. Two joints were redesigned with interlocking walls that had new bolts, pins, sensors, seals, and a third O-ring.



●●● In December 1994, parachutes (three per booster) were enlarged from 115 feet in diameter to 136 feet, slowing the jettisoned boosters' descent, which reduced their damage at impact in the Atlantic Ocean. And to minimize damage during deployment, the chutes were packed in a circular, rather than zig-zag, pattern. ▲

●●● Propellant grain was modified after 2003 to avoid cracks in the fuel when the boosters are stored horizontally at temperatures below 40 degrees Fahrenheit.





External Tank

●●● Before the loss of *Columbia* and its seven astronauts on STS-107 (January-February 2003), the base of the connection between the tank and the orbiter's nose was insulated with ramp-like foam panels to prevent ice from forming (right, top). It was a piece of this foam that broke away during *Columbia*'s ascent and damaged the leading edge of the left wing, creating the condition that led to the destruction of the orbiter on reentry. On future flights, heaters replaced the foam panels. ▶



●●● For the first two missions in 1981, the tank was painted white to protect its insulating foam from the sun's ultraviolet rays while on the launch pad. Eliminating the paint allowed the shuttle to carry 600 more pounds of payload. ◀

●●● Design changes, welding improvements, and the use of aluminum-lithium alloys have cut the tank's weight. In 1981 and 1982, it weighed 77,100 pounds empty. STS-6 (April 1983) introduced a lighter tank: 66,800 pounds. With STS-91 (June 1998) came one even



LOCKHEED MARTIN SPACE SYSTEMS-MICHOUD OPERATIONS (2)

lighter: 57,470 pounds. The savings enabled the shuttle to carry increasingly heavier payloads.

●●● After STS-107, six cameras were added to six already on the shuttle system to monitor foam loss during ascent. They're mounted on the boosters (three on each), on or in the orbiter (five), and on the tank (one).

Space Shuttle Main Engines

●●● In 1995, the power head was narrowed from a three-duct injector design



to a two-duct one, and in 1998 the combustion chamber's throat was enlarged. The changes reduced internal engine pressures and increased safety margins. ◀

●●● To reduce friction from the oxidizer pump's 23,000 revolutions per minute and the hydrogen fuel pump's 34,800 rpm, silicon-nitride bearings were added to the two high-pressure turbo-pumps in 1995. In the oxidizer pump, the number of rotating elements was reduced from 50 to 28, while the number of bearings dropped from four to three. In the fuel pump, the rotating elements went from 30 to 14, and the bearings from five to two. The new oxidizer pump first flew on STS-70 (July 1995), while the new hydrogen fuel pump debuted on STS-104 (July 2001).

ALL PHOTOGRAPHS NASA EXCEPT NOTED

Space Shuttle Main Engines

(continued)

●●● Starting with STS-117 (June 2007), new onboard computers and sensors began providing better real-time monitoring of vibration loads in the turbopumps.

●●● High-precision casting during manufacturing has reduced the number of welds, cutting the number of engine inspections needed between flights.



The shuttle main engine is the most tested large rocket engine in the world. In 1996, a turbine component (displayed here by a NASA scientist) underwent airflow tests to help engineers create more efficient aircraft engines.

Orbiter

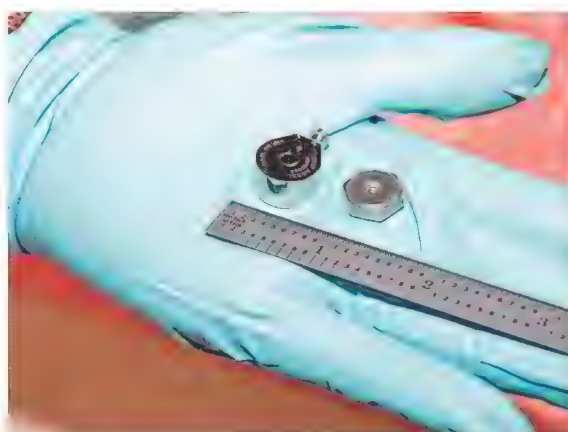
●●● Starting with STS-49 (May 1992), orbiters used a drag chute on landing, which relieves wear on the brakes and reduces rollout distance by up to 2,000 feet. ▼



●●● On the first four missions (1981-82), which each had only two astronauts, the shuttle had modified SR-71 Blackbird ejection seats. On STS-5, with a crew of four, the seats were disabled, and after STS-9 (November-December 1983), they were removed. Starting with return-to-flight STS-26 (September 1988), a telescoping slide-pole was installed to enable crew escape through the side hatch when the orbiter was below 30,000 feet and in a glide no faster than 230 mph.

●●● The original airlock was 150 cubic feet and located inside the mid-deck, with one hatch opening into the mid-deck and the other into the payload bay. In the early 1990s, the airlock was enlarged to 185 cubic feet and moved into the payload bay, with a third hatch at the top for docking with the Russian space station Mir (1995-98) and the International Space Station (starting with STS-88, December 1998).

●●● Beginning in 1995, crew seats were made with aluminum alloys, which cut their weight from 110 pounds to 49.



●●● After January 2003, the wing leading edges were fitted with 66 tiny sensors, each of which makes 20,000 readings per second to detect impacts. To protect against impacts, NASA hardened the tiles on wing leading edges and added reinforced carbon-carbon blankets under the nose. ◀

●●● The shuttle has deployed six Tracking and Data Relay Satellites, beginning with



Shuttle Remote Manipulator System

●●● First used on STS-2 (November 1981), the 50-foot-long, Canadian-built arm was designed to deploy and retrieve payloads weighing up to 65,000 pounds. Work on the ISS, begun in the mid-1990s, raised the requirement to 586,000 pounds, so the “wrist” got greater torque, enabling it to assist, if needed, in docking the shuttle to the station. The arm, however, was never used for that purpose.

●●● In 2000, all joints were refurbished, gear boxes and motor modules replaced, and, for better stability in space, asbestos brakes were swapped out in favor of ceramic ones.

●●● Starting with return-to-flight mission STS-114 (July 2005), NASA added a 50-foot extension to allow the crew to examine the shuttle’s belly for signs of foam impact damage. ▲

The glass cockpit (below) is 75 pounds lighter than the old electro-mechanical display, uses less power, and helps pilots more easily interpret complex data on the shuttle’s systems.



STS-6 (April 1983). The satellites, along with three more sent up on Atlas IIA rockets, provide near-continuous communication during missions. Before TDRS, astronauts could talk to mission control only about 15 percent of the time while in orbit. ▲

●●● A glass cockpit, with 11 flat panel color displays, replaced 32 dials and gauges starting with STS-101 (May 2000). ►



ERIC LONG



MEDEVAC

From Luzon

A SMALL BAND OF HELICOPTER PILOTS RISKED THEIR LIVES TO RESCUE WOUNDED SOLDIERS DURING WORLD WAR II.

BY ROGER CONNOR

LOUIS CARLE THOUGHT HIS HELICOPTER was small enough to land in a clearing on a jungle hilltop in Luzon. It was June 1945, the waning days of the Pacific war, and Carle, a second lieutenant in the U.S. Army Air Forces, was trying to evacuate a wounded American soldier from the main island in the Philippines. Carle began a cautious descent in his Sikorsky R-4B, but a rotor tip hit a tree, and with an abrupt jerk, the helicopter began thrashing itself to pieces.

After the helicopter hit the ground, Carle was helped from the wreckage. He found himself sitting in the midst of a small band of U.S. soldiers. Nearby, starving but well-armed Japanese squads were determined to resist to the end. With injuries to his head and leg and a splinter of a wood rotor blade lodged behind his right eye, Carle had no choice but to order the U.S. soldiers to fire bazooka rounds into the wreckage and destroy his helicopter. He then began an arduous trek out of the mountainous jungle. Before he reached safety, he encountered one of the Japanese soldiers. Carle, armed with a pistol, shot and killed him.

From June 15 to July 29, 1945, Carle and five other pilots evacuated 75 to 80 wounded soldiers, one or two at a time, from the highlands northeast of Manila. Although they were not the first helicopter pilots to fly in combat—that distinction belongs to Lieutenant Carter Harman of the First Air Commando Group, who flew the first medical evacuations, in Burma on April 23, 1944—they were the first to be targeted by enemy fire: Japanese soldiers tried to shoot them down with machine guns. Their six-week effort constitutes the largest combat helicopter operation before the Korean War, yet their contributions remain largely unknown.

The evacuation of casualties had been contemplated as a mission that helicopters could perform for the armed services, but it is not the mission that the six pilots were trained for, and it is not why their first-generation helicopters were sent to the Philippines. Pilots and helicopters had been assigned to the Pacific theater to ferry aircraft parts for a program known as Project Ivory Soap. With this project, the Army Air Forces used U.S. Army-owned ships as floating depots to maintain the aircraft of groups stationed in the Pacific. Early in the war, air groups often waited months for replacement parts and supplies to reach the Pacific isles on which they were based; with repair ships floating nearby, aircraft could be turned around much faster.

By December 1943, Project Ivory Soap had evolved into a fleet of six Liberty ships, designated Aircraft

Repair Units (Floating), and 18 smaller ships, designated Aircraft Maintenance Units (Floating). In the final year of the war, the program proved essential for maintaining the tempo of Pacific-based aircraft operations by conducting nearly all of the most intensive maintenance functions, with the exception of engine overhaul.

By far the most distinctive feature of the floating repair ships was their helicopters. In addition to the R-4B, Sikorsky had made two other helicopters for World War II: the R-5 and R-6. The R-4 was a trainer intended merely to introduce the helicopter's potential to the military; the R-6 was a further evolution, designed as a liaison aircraft. The R-5 was the true workhorse, the only one of the group capable of lifting a substantial load.

Unfortunately, the much larger R-5 suffered a series of engineering delays and was not ready for deployment until several months after the war ended. The R-6 also suffered delays, but saw limited service in the last three months of the war. That left the lowly R-4 trainer to bear the brunt of helicopter



For the wounded on Luzon in 1945, the Sikorsky R-6A transport (opposite) doubled as an ambulance. The helicopters were stationed on aircraft repair ships outfitted with 40- by 72-foot landing decks (above).



ARMY AIR FORCES

Helicopters, including the R-4B, had been assigned to the Pacific theater not to evacuate the injured but to ferry replacement parts for U.S. Boeing B-29s.

operations from April 1944 onward. Under ideal conditions, the R-4 could carry, in addition to the pilot and fuel, only 195 pounds, which meant only instruments and small components such as propeller hubs. But the timely delivery of even small payloads was highly valued.

The First Aircraft Repair Unit deployed on October 11, 1944, and by the following February, all six vessels were in the Pacific. At the start of June 1945, the Third, Fifth, and Sixth Aircraft Repair Units were operating in the Philippines, supporting the Fifth Air Force, while the remaining three supported the 20th Air Force in the Marianas. (The First and Second Aircraft Repair Units were specially equipped and trained to support B-29s in the Marianas, including repair of their radar and complex central fire control systems.) Each of the ships had a 40- by 72-foot steel deck for helicopter operations.

Carle and First Lieutenant Robert Cowgill were assigned to the Fifth Aircraft Repair Unit. On June 15, with Cowgill away to pick up the first Sikorsky R-6A to make it into the theater, the Fifth Air Force received a request from the 38th Infantry Division to evacuate two soldiers with head injuries from a spot 35 miles east of Manila.

Carle was immediately dispatched in one of the unit's R-4s. Reaching what he thought was the designated spot, Carle recalled: "All hell broke loose as a hail of 100-pound bombs started dropping all around me. I got out of there but quick. When I got my breath back, I saw a squadron of P-47s dive-bombing the spot I had just been flying." (Carle gave accounts of his rescue missions to Fred Duncan, the historian of the aircraft repair units, and me. We interviewed Carle and the other Ivory Soap pilots in 2000 and 2001 as part of an oral history project for the National Air and Space Museum. Carle died in 2000.)

As Carle landed at a forward position on Luzon, soldiers greeted him with incredulous looks and comments on his "monstrosity from the sky."

They, like the vast majority of Americans at the time, had never seen a helicopter. The soldiers had no information on the wounded whom Carle had come to collect, but they did know of a platoon leader with a bullet-shattered hip; he was part of a patrol that had been cut off near a narrow river bank.

Arriving at the location, Carle realized just how unprepared he was for the mission. When deployed to the theater, he had a mere 25 hours of helicopter time, and no training in medical evacuation, com-

bat flying, or landing in a jungle. While R-4s had had external stretcher mounts installed in trials, the R-4s assigned to the aircraft repair ships had no such equipment, and Carle had not given a thought as to how a two-seat trainer might evacuate somebody. “As I stepped from the ship, a grimy, bearded sergeant grabbed my hand and began pumping it, welcoming me as though I was his long-lost brother,” said Carle. “At the same time, he explained what had happened to his patrol leader, and asked for instructions for loading the stretcher. Somewhere he had read that a stretcher can be loaded onto a helicopter. His spirits seemed to drop to the earth when he heard that I had never seen a stretcher used on a helicopter and knew of no way to load a stretcher patient onto the R-4. One of his buddies spoke up, asking if a seat could be removed and the man placed on the floor. It could be done, and we did it.”

Carle also disconnected the cyclic stick, but the wounded lieutenant’s feet still had to be propped up on the rudder pedals with a seat cushion, an arrangement that, Carle noted, “served as a ‘rudder lock’ and gave me absolutely no control over the tail rotor.” After an ungainly takeoff, Carle slowly climbed away and was able to deliver his patient to the 311th General Field Hospital near Manila.

News of the successful evacuation spread quickly, and calls for Carle’s services started to pour in.

On June 17, Cowgill returned with the newly assembled R-6A; though this helicopter could perform slightly better than the R-4B, its cabin was even tighter. Carle evacuated the wounded who were unable to stand or sit, while Cowgill evacuated those who could walk. Both men quickly became exhausted. Carle remembered: “More and more units requested our services, until we were overloaded with work, as can be indicated by the fact that I flew seven hours and made six evacuations on the same day.”

By the standards of Korea and Vietnam, Carle’s workload seems trivial, but the R-4B was a far more demanding machine than its successors. The R-4B’s blades were constructed of wood ribs around a steel spar and covered with doped fabric. They were difficult to keep in track (rotating in the same plane) and vibrated excessively. The pilot’s cyclic stick made continuous small orbits, never staying completely stationary. There was no governor to control rotor speed, and the pilot had to correlate the throttle continuously with collective pitch inputs. In one of the only instances of public coverage given to the Ivory Soap helo pilots, a June 21, 1945 *Chicago Tribune* article reporting on Carle’s initial efforts noted: “Driving the ‘eggbeater’ is hard work. The control stick shakes like a jackhammer, and the pilot must hold it tightly at all times. Should he relax for even a minute the [helicopter] falls out of control. Pilots of regular planes say it’s easy to identify a helicopter pilot—he has a permanent case of the shakes.”

Besides wrestling with the helicopters, the pilots had to load and unload the wounded without assistants, which only added to the job’s stress. Not all of the pilots assigned to the aircraft repair units were suited to the medical evacuation missions. First Lieutenant Harold “Pappy” Greene walked away from helicopters after flying only two evacuations, swearing he would “never fly another helicopter—ever.”

Carle and Cowgill found their evacuations becoming more difficult. The pilots continued to discover unanticipated limitations on these first-gen-

Besides wrestling with the helicopters, the pilots had to load and unload the wounded without assistants, which only added to the job’s stress. First Lieutenant Harold “Pappy” Greene walked away from helicopters after flying only two evacuations.

Left: Louis Carle and Robert Cowgill (in sunglasses) improvised rescue techniques. Because the R-4B (below) had no external stretcher mounts, Carle removed a seat so an injured man could lie on the floor.



NASM 9A07870



NASM 9A07871

eration production rotorcraft. Cowgill recalled that though the R-6 was intended as an improvement on the hastily designed (and perhaps overbuilt) R-4, it seemed to have numerous defects and was an even trickier machine to fly. “They had the fuel tank in

front of the center of lift...so when you ran [low] on fuel, the nose began to rise and you would run out of forward stick if you [were] alone,” said Cowgill. “I had to stop once and put a stone up in the front to trim it up enough. It was just a completely stupid goof.”

Carle’s final disastrous evacuation demonstrated just how far beyond the design limits of the R-4B the pilots were going. With the heat, humidity, and altitude characteristic of central Luzon, the payload of the R-4 was essentially zero. To get

off the ground, Carle had to employ a dangerous technique: the jump takeoff. In an article he wrote for the January 1947 issue of *American Helicopter* magazine, he recalled that he deliberately oversped his engine and rotor rpm past redline to “2,600 [engine] rpm and [pulled] 7.5 degrees pitch to start the takeoff,” causing the helicopter to leap into the air. The technique had numerous hazards, including the helicopter settling back onto the ground. Another danger was that either stress or the increasing air pressure at the blade tips would cause the blades to fail structurally. Overrevving did the engine no favors either, but Carle later instructed future helicopter pilots that “such a high rpm may shorten the life of the engine, but it will lengthen the life of the pilot.”

The high-torque maneuver also overwhelmed the R-4B’s tail rotor, and the “torque caused the tail to swing almost 90 degrees to the left.” The helicopter was then in an awkward position to depart the tight

clearing, but Carle made the best of it. As his helicopter moved sideways, the rotor began to enter what is now known as “effective translational lift,” in which a forward influx of airflow increases rotor efficiency, providing just enough improvement in performance to keep the helicopter from settling onto the ground. Carle then noted that “as the ship picked up speed, the action of the wind swung the tail partially behind me...[but], as I started it soon became apparent that the 210 pounds of my passenger, plus the altitude of 1,500 feet were going to make it impossible to clear the high trees. The rpm was dropping rapidly, and the airspeed was near zero. I was at the limit of my climb and still the tops of the trees were above me. I couldn’t turn back without dropping straight in, probably killing the passenger and myself, so I jerked the pitch control as high as it would go and luckily we cleared the trees by inches, but the effort had cost [rotor rpm] and all of my airspeed.

“As soon as I realized that we were clear of the trees, I dropped the pitch to 4 degrees and held full throttle, at the same time pushing forward on the stick. As the rpm came back within the green, I increased the pitch and fortunately missed dropping into the jungle. Again, the rpm dropped, and again I lowered the pitch enough to bring it back. The airspeed was building slowly and we began to climb to safety. What had actually been a few seconds seemed an eternity. My clothes were drenched with sweat, and I was so weak that I could hardly move the controls.”

Carle’s experiences presaged those of countless combat helicopter pilots in the Korean and Vietnam wars, who were forced to master flying overloaded aircraft into tight landing zones; his recollections vividly illustrate just how risky these early operations were. On June 21, Carle and Cowgill both ran out of luck. Carle’s rotor tip hit a tree, and almost simultaneously, Cowgill, flying an equally treacher-

On June 21, Carle and Cowgill both ran out of luck. Almost simultaneously with Carle’s crash, Cowgill, flying an equally treacherous approach in the R-6A, clipped a tree with the tail rotor.

Flying his R-6A, Cowgill delivers a wounded soldier to an ambulance at the Grace Park Cub Strip near Manila. He would end up flying 14 evacuations.



ARMY SIGNAL CORPS



DANE PENLAND

Simple Stability Its steel-tube frame covered with fabric, the Sikorsky XR-4 spawned the R-4, the world's first mass-produced helicopter. The one and only XR-4 prototype is on display at the Smithsonian's Steven F. Udvar-Hazy Center in northern Virginia; it was donated by the U.S. Air Force in 1947.

ous approach in the R-6A, clipped a tree with the tail rotor. Fortunately, the troops at his landing zone were well positioned, and were able to post a guard to watch the aircraft (recovered a week later). Cowgill marched out of the jungle with an escort on a harrowing four-day journey in which he too encountered determined Japanese opposition.

The two crashes ended the Fifth Aircraft Repair Unit's participation in the operation, as their ship was preparing to support the newly captured airfields on Okinawa. After Carle deployed with his vessel to Okinawa, the war ended. He went back to Luzon to fly R-6As with the Second Emergency Rescue Squadron, which was adding helicopters to an extensive stable of fixed-wing rescue aircraft. After returning to the United States, he suffered persistent pain from the rotor fragment in his skull and never flew helicopters again.

Carle was officially credited with a dozen evacuations (though he may have flown more), and Cowgill with 14.

On June 25, the Sixth Aircraft Repair Unit arrived in Manila Bay, and began rescue operations with their own R-4B and R-6A. In the span of only four

days, pilots First Lieutenant James Brown, Second Lieutenant John Noll, and Flight Officer Edward Ciccolella rescued around 40 wounded. In the process, they introduced a significant innovation to the battlefield. Though Sikorsky engineers had designed slots running through the R-6's frame to mount two encased litter pods, none of the R-6s deployed with the equipment. The helicopter mechanics assigned to the Sixth Aircraft Repair Unit improvised external litters using Stokes baskets (steel-tube and wire-mesh baskets used to transport the injured) welded to steel frames. In this way, prone casualties could be carried without risk to the helicopter.

A small number of additional evacuations took place in July. Of the helicopter evacuations of wounded soldiers and airmen in the Pacific and Far East during the war, more than 60 percent were rescued during the operation on Luzon. Helicopter rescue was in no way decisive to World War II—125 to 150 wounded were evacuated, compared with approximately 40,000 in Korea and well over a million in Vietnam—but it was a huge step in convincing the military that rotary wing flight was a useful battlefield technology. ✈

Then & Now

FROZEN MOMENTS AS TIME MARCHES ON

Business Models

THE FORERUNNERS of today's business jets were multi-use airplanes known not for their opulence but their versatility. One of the earliest, the Beechcraft Model 18, performed a variety of roles, from military trainer to air ambulance.

"It was just so adaptable, that's the beauty of the design," says Dorothy Cochrane, curator of general aviation at the National Air and Space Museum, which has a Beechcraft D-18S on display. "It was an airline feeder, a utility transport, a floatplane, a snowplane. At one point, it was a bomber trainer with a gun turret."

The Museum's Model 18 is one of 9,000 copies that Beech Aircraft Corporation has built since 1937. "Anything that lasts for a 32-year production run has to be pretty damn good," says Cochrane.

After the all-metal monoplane was converted into transportation for business executives in the 1940s, sales of the Model 18 sustained the company for decades. "The Beech 18 found a niche in business aviation and [the company] stuck with it for sheer economic reasons," says Museum curator Von Hardesty.

The airplane's production line was

The Model 18 was the Beech company's breadwinner for three decades.



Cessna's Citation X hasn't played as many roles as its propeller-driven ancestors, but the business jet is speedier than all the rest.

closing when, in September 1969, rival Cessna Aircraft Company test-flew a turbine-engine model called the FanJet 500. Cessna soon renamed it after a Thoroughbred horse, the 1948 Triple Crown winner Citation.

By 2009, the company had delivered more than 6,000, making Citations the world's largest family of business jets. Business aviation suffered from negative media coverage

in late 2008 and 2009 when the CEOs of Detroit's automakers, coming to Washington, D.C., to ask Congress for financial assistance, all flew in on private jets. Sensitive to

the criticism, the National Business Aviation Association last October expanded its "No Plane, No Gain" campaign with talking points to help bizjet owners and their customers characterize the jets as necessities rather than luxuries. "In this tough economy, we need to reach as many customers in as little time as possible, as airlines have pared down schedules and ceased service," the NBAA suggests in a sample letter.

Much as the Model 18 was the mainstay for Beech, Cessna's Citation X is the only variant to have sold in every year since its certification in 1996, and is Cessna's biggest and fastest jet. Golf legend Arnold Palmer bought the first one, and sales have held steady at 12 to 26 per year.

The Beech 18 was a speedster in its time; Walter Beech set a record in one in 1940, when he flew from St. Louis to Miami at 234 mph. Speed may be the key to the Citation's success. With maximum cruise at 604 mph, it is the fastest civilian jet flying.

ROGER A. MOLA



Advertisement



We Apologize That It Loses 1 Second Every 20 Million Years

First Super Light Titanium Timepiece Under \$200 With Precision to 1 Billionth of a Second.

The U.S. government has engineered the most ingenious, most accurate clock in the world: the F-1 U.S. Atomic Clock in Boulder, Colorado. Our extraordinary new Stauer Titanium Atomic Watch utilizes the transmissions directly from that remarkable cesium fission atomic clock to report the most precise time. This scientifically advanced timepiece will gain or lose only one second over a 20 million-year period. It is that accurate! This perfectly tuned technological invention with the super light strength of titanium is now available for UNDER \$200.

Super Light Titanium has two big advantages over steel. One is corrosion resistance and the other is that titanium has the highest strength-to-weight ratio of any metal, which means that titanium is approximately 45% lighter than steel. But every other titanium watch that we can find is priced at over \$400, and none of those

are nearly as accurate as our atomic movement. Stauer has decided to bring these resources together in a timepiece that has the most accurate movement available today. You'll never have to set this watch. Just push one of the buttons and you are synchronized with the atomic clock in Colorado, and the hands of the watch move to the exact time position. The sleek black textured dial has luminous hands and markers plus the timepiece is water resistant to 3 ATM.

A Titanium-clad offer. This Titanium Atomic Watch exceeds the accuracy of any Swiss luxury automatic so you can be more punctual and keep most of your money in your wallet, not on your wrist. Look at your watch and we guarantee that the time is incorrect, unless you are wearing the advanced atomic technology.

The Stauer Titanium Atomic Watch is not available in stores and it comes with our

30 day money-back guarantee. If you're not completely satisfied with the accuracy, simply return the watch for the full purchase price.



Not Available in Stores

Stauer Titanium Atomic Watch ~~\$195~~ **now \$145** +S&H

or 2 credit card payments of \$72.50 +S&H

Call Toll-Free now to take advantage of this limited offer.

1-888-201-7141

Promotional Code TTA350-05
Please mention this code when you call.

To order by mail, please call for details.

Stauer
HERITAGE OF ART & SCIENCE

14101 Southcross Drive W.,
Dept. TTA350-05
Burnsville, Minnesota 55337
www.stauer.com

Reviews & Previews

BOOKS, MOVIES, CDs, STUFF TO BUY

A Man of Vision

Aviation pioneer Glenn Curtiss believed that the U.S. Navy needed airplanes as much as it needed ships.



On icy Lake Keuka, a member of the Aerial Experiment Association holds *Red Wing*, which Glenn Curtiss helped the group build in 1908.

Hero of the Air: Glenn Curtiss and the Birth of Naval Aviation

by William F. Trimble. Naval Institute Press, 2010. 270 pp., \$37.95.

GLENN CURTISS FLEW higher, faster, and farther—not first. His place in history worried the Wright brothers more than it ever did him. In *Hero of the Air*, William F. Trimble chronicles the plain-spoken mechanic cradle to grave, and examines his central role in naval aviation's birth. There are 483 footnotes. Curtiss would skip them.

He practiced “cut and try” engineering on a breakneck learning curve. Hanging in his wide-open workshop in upstate New York wine country sure sounds more interesting than spending time with the secretive brothers in Dayton. Their respective

two-wheel beginnings are telling, and Trimble gets it: the Wrights’ sensible, finely crafted bicycles versus Curtiss on a kick-butt eight-cylinder racing motorcycle. Always, Curtiss favored superior propulsion over finesse. In Alexander Graham Bell’s Aerial Experiment Association, he built and piloted airplanes to altitude and speed records. He also believed in rugged simplicity: a single, direct-drive propeller, and user-friendly ailerons instead of the Wrights’ ingenious but geeky wing-warping method. Curtiss mass-produced airplanes for profit and flew paid exhibitions tirelessly. Wilbur and Orville had a word for that: infringement.

“They don’t own the air,” Curtiss countered, but patent lawsuits proliferated. Trimble describes encounters between the free-

wheeling Curtiss and the lawyered-up Wrights, pervaded with frozen-smile civility. You wish you’d been a fly on the wall.

Water takeoffs and landings, Curtiss wrote as early as 1908, “have been on my mind for some time.” As he doggedly perfects pontoon hydroaeroplanes, the U.S. Navy dispatches observers, then trains pilots. Never again would aviation be so straightforward and intuitive. Aerodynamic theory and data-driven designs overwhelmed what Trimble terms Curtiss’ “shop culture.”

Hero of the Air conjures the thrills and spills of early carrier flights, but flattop fans like me may be disappointed that Curtiss’ involvement—and the book—end mostly before that era. Trimble often

Continued on page 74

TO ORDER THESE BOOKS FROM SMITHSONIAN SHOPS, CALL (202) 357-1387 OR -1388.



Finally, a cell phone that's... a phone!

"Well, I finally did it. I finally decided to enter the digital age and get a cell phone. My kids have been bugging me, my book group made fun of me, and the last straw was when my car broke down, and I was stuck by the highway for an hour before someone stopped to help. But when I went to the cell phone store, I almost changed my mind. The phones are so small I can't see the numbers, much less push the right one. They all have cameras, computers and a "global-positioning" something or other that's supposed to spot me from space. Goodness, all I want to do is to be able to talk to my grandkids! The people at the store weren't much help. They couldn't understand why someone wouldn't want a phone the size of a postage stamp. And the rate plans! They were complicated, confusing, and expensive... and the contract lasted for two years! I'd almost given up when a friend told me about her new Jitterbug phone. Now, I have the convenience and safety of being able to stay in touch... with a phone I can actually use."

Questions about Jitterbug?

Try our pre-recorded Toll-Free Hotline 1-877-760-8934.

The cell phone that's right for me. Sometimes I think the people who designed this phone and the rate plans had me in mind. The phone fits easily in my pocket, but it flips open and reaches from my mouth to my ear. The display is large and backlit, so I can actually see who is calling. With a push of a button I can amplify the volume, and if I don't know a number, I can simply push one for a friendly, helpful operator that will look it up and even dial it for me. The Jitterbug also reduces background noise, making the sound loud and clear. There's even a dial tone, so I know the phone is ready to use.

Affordable plans that I can understand – and no contract to sign! Unlike other cell phones, Jitterbug has plans that make sense. Why should I pay for minutes I'm never going to use? And if I do talk more than I plan, I won't find myself with no minutes like my friend who has a prepaid phone. Best of all, there is no contract to sign – so I'm not locked in for years at a time or subject to termination fees. The U.S. – based customer service is second to none, and the phone gets service virtually anywhere in the country.

Monthly Minutes	50	100
Monthly Rate	\$14.99	\$19.99
Operator Assistance	24/7	24/7
911 Access	FREE	FREE
Long Distance Calls	No add'l charge	No add'l charge
Voice Dial	FREE	FREE
Nationwide Coverage	Yes	Yes
Trial Period	30 days	30 days

Other plans available. Ask your Jitterbug expert for details.

FREE Gift

Order now
and receive a
free Car Charger.
A \$24 value!



New Red
phone shown
Also available
in White and Graphite.



Call now and get a FREE GIFT. Try Jitterbug for 30 days and if you don't love it, just return it. Why wait, the Jitterbug comes ready to use right out of the box. The phone comes preprogrammed with your favorite numbers, and if you aren't as happy with it as I am you can return it for a refund of the purchase price. Call now, the Jitterbug product experts are ready to answer your questions.

jitterbug®



firstSTREET®
for Boomers and Beyond®
1998 Ruffin Mill Road
Colonial Heights, VA 23834

Jitterbug Cell Phone

Call now for our lowest price.
Please mention promotional code 40299.

1-888-676-0427
www.jitterbugdirect.com

IMPORTANT CONSUMER INFORMATION: All rate plans require the purchase of a Jitterbug phone and a one-time set up fee of \$35.00. Coverage and service is not available everywhere. There are no additional fees to call Jitterbug's 24-hour U.S. Based Customer Service. However, for calls to an Operator in which a service is completed, minutes will be deducted from your monthly balance equal to the length of the call and any called connected by the Operator, plus an additional 5 minutes. Rate plans do not include government taxes or assessment surcharges. Prices and fees are subject to change. Savings are based on marketing materials from nationally available cellular companies as of June, 2010 (not including family share plans). The full price of the Jitterbug Phone will be refunded if it is returned within 30 days of purchase, in like-new condition, and with less than 30 minutes of usage. A Jitterbug Phone purchased from a retail location is subject to the return policy of that retail location. The Jitterbug phone is created together with worldwide leader Samsung. Jitterbug is a registered trademark of GreatCall, Inc. Samsung is a registered trademark of Samsung Electronics America, Inc. and its related entities. Created together with worldwide leader Samsung. Copyright © 2010 by firstSTREET for Boomers and Beyond, Inc. All rights reserved.



TO GIVE OUR READERS the opportunity to dig deeper into books about aviation and space, *Air & Space/Smithsonian* is organizing an online book club. The first selection is *Fighter Pilot*, the memoirs of legendary triple ace Robin Olds, a U.S. Air Force pilot who flew P-51s in World War II and who, by all accounts, shook things up in an F-4 wing in Vietnam. Those who would like to participate are encouraged to read the book in preparation for the online discussion on the *Air & Space* Web site in July. The book's coauthor, Christina Olds (Robin's daughter), will be available to answer questions from readers. For more details, visit www.airspacemag.com/bookclub.

Fighter Pilot: The Memoirs of Legendary Ace Robin Olds

by Robin Olds with C. Olds and Ed Rasimus. St. Martins Press, 2010. 400 pp., \$26.99.

The following is an excerpt from the chapter "The Phantom and the War," which details Olds' experience as the commanding officer of the 8th Tactical Fighter Wing, which flew F-4 Phantoms out of Thailand during the Vietnam War.

THAT NIGHT I HEADED to the officers' club, which wasn't far from my trailer. I met several of the guys and started talking to them over beer. It was easy to tell they didn't know what to make of me, and it was also pretty obvious they had little respect for wing commanders. Well, why should they? None of the commanders flew much; therefore, they knew little about the missions. I got hold of Pappy Garrison and told him to gather all the pilots in the morning for a meeting. He told me this would be the first time a full wing pilots' meeting had been held. Despite the staggered mission schedule, the

pilots had never been briefed all at the same time? They were in for a surprise. It had been 22 years since I'd fought in a war, but it was obvious where my task lay.

The next morning, I let the pilots stew together over [the new CO] for a little bit before I entered the briefing room, walked to the front, and turned to face them. They got quiet and their eyes glazed over. I glared at them silently for a moment and began, "My name is Olds and I'm your new boss. I've been around the air force a little while and I'm really glad to be here. You guys know a lot that I don't know and I'm here to learn from you. I'll be flying

as your wingman for a couple of weeks. You are going to teach me, but you'd better teach me good and you'd better teach me fast. When you get me ready, I'll be Mission Commander, and we'll get it done together. Now, you just stay ahead of me because as long as you know more than I do, we are going to get along just fine. I will listen to you and learn from you, but soon I'm gonna be better than all of you, and when I know more about your job than you do, look out."

From somewhere in the middle of the room came a quietly drawn out, "I see." The tone was a sarcastic "Yeah, right, Colonel," and I immediately sought out the offender. I could tell it had come out a little louder than

he'd intended. My glance fell hard on a guy at the end of a row, Captain J.B. Stone, but slid quickly to the snickering major beside him, Cliff Dunnegan. I'd see about them both.

Over the next several days, I let the guys train me. I wanted to see where the action was right away and I got what I wanted. Regularly I'd give the guys in the briefing room the same goading speech, "I'm gonna be better than you!" As soon as they stopped being pissed off, they got into the spirit of the challenge. When we weren't flying, I was stalking through the base looking over their shoulders, visiting the squadrons and hanging out with them at the O club. Pretty soon, I knew all of their names. They taught me well, both on the ground and in the air. I was out in front in less than two weeks.

Copyright © 2010 by Robin Olds with Christina Olds and Ed Rasimus.



In World War II, Robin Olds also flew P-38s while stationed in England.

claroxan


PACIFICHEALTH

CALL 866.775.3937 OR VISIT WWW.CLAROXAN.COM TO LEARN MORE



Brian Grote is a flight instructor with years aviation experience. He also writes monthly columns on subjects pertaining to aviation.

FLYBY

ARTICLE WRITTEN BY: BRIAN GROTE

Dear Brian,

I've been flying for over 20 years. My usual run is a Denver departure at 9pm, fly to Billings, on to Cheyenne and then back to Denver by 5am. I fly a King Air 350. I love my career and I pride myself on doing the best job I possibly can.

Last time out, however, I was making lots of little mistakes. I was cleared for the ILS Runway 35R into Denver, but I couldn't pick up ATIS. That's when I looked at my radios and noticed I had dialed in the wrong frequency. I glanced again and dialed in the right frequency. I continued through my checklist and set my Radar Altimeter to 5500 feet. I was ready to make my descent and start my approach. After the outer marker I glanced at my DH again and noticed that I had set my Radar Altimeter, 67 feet low. Luckily, I landed safely, bouncing the wheels just a little.

After a couple more days in the sky I could tell my eyesight was beginning to deteriorate. I knew I wouldn't be able to renew my first class medical if I didn't do anything about it. I was really worried and started asking my peers if there was anything I could do. A co-worker gave me a bottle of Claroxan™ and told me it would help me maintain my depth perception. I was skeptical at first, but tried it anyway. As it turns out, the stuff works great. The problem is, I ran out and don't know where to find more. Have you heard of this Claroxan™ stuff? Is it available in the States?

Jason, 46 – Seattle, WA

Jason,

Not only do I know of Claroxan™, it just so happens I take it everyday. Being a pilot myself, I know that perfect visual acuity is an asset none of us can afford to lose. That's why every pilot should be protecting their eyesight before it's too late.

Claroxan™ contains ingredients proven beneficial for the eyes. Among these ingredients are lutein and zeaxanthin – powerful antioxidants that have been clinically proven to protect the retina and macula and, in some cases, reverse the damaging effects of macular degeneration. These antioxidants block damaging UV rays and halt damaging free radical oxidation in the back of the eyes. They have also been clinically proven to decrease the risk of cataracts.

Claroxan™ also contains bilberry, an antioxidant known to improve night vision. Bilberry's night vision enhancing effects were first noticed in England in the early 1940's. The RAF ordered English fighter pilots to eat bilberry jam on toast figuring it would give them an advantage during night raid missions against the German Luftwaffe fighters.

Claroxan's unique proprietary formulation is completely safe, all-natural and extremely affordable. As far as ordering it, you can call them toll-free at 866.775.3937, or go to www.claroxan.com. I usually get mine within a week after ordering.

*Hope this helps!
Brian*

THE Himalayan CATARACT project

The Himalayan Cataract Project strives to eradicate preventable and curable blindness in the Himalayas through high-quality ophthalmic care, education, and establishment of a sustainable eye care infrastructure.

Based in Asia, at Kathmandu in Nepal, the Project is empowering local physicians to alleviate the suffering caused by blindness through unique programs including skills-transfer education, cost-recovery, research, and the creation of a world-class network of eye care facilities.

In years past, PacificHealth donated a portion of profits to HCP for development and construction of eye facilities in the Himalayas.

Visit CureBlindness.org to learn more about HCP.



CLAROXAN™ | LEADER IN VISION IMPROVEMENT

Sunlight, aging, and diet each cause damage to the retina and macula, which can lead to a decline in vision that glasses or contacts can't help. If you've experienced an increase in blurriness or have difficulty seeing details at any range, then you know how valuable sharp vision can be. What you might not know is that in the past three years, a flood of new scientific research has been done on natural vision enhancement. This medical research suggests that ingredients in Claroxan™ may help maintain and even improve your vision, while at the same time giving you added protection against many ocular diseases.

Claroxan™ may improve macular pigment density, which research shows has amazing effects on vision. By improving macular pigment density, ingredients in Claroxan™ may improve normal

visual acuity, contrast sensitivity, and even glare reduction. Participants in one clinical study reported that ingredients in Claroxan™ improved their long range vision outdoors – in some cases, they were able to distinguish far away ridges up to 27 miles further than normal! Even if you have perfect vision now, Claroxan™ may help give you an edge by improving your visual reflexes and may allow you to pick up on moving objects faster than ever before.

People who count on their vision – people like pilots, hunters, military, and even pro athletes – trust Claroxan™ as the best source available for vision enhancement and protection. Claroxan™ is safe, effective, and extremely affordable. However, people with serious health concerns should consult a doctor before use.





**We wanted to give mom
and dad something back...
Their independence.**

As Seen
On TV!

Mom and dad have done a lot for us, that's why we wanted to do something for them in return.

So, we talked to Premier Care about their extensive range of Walk-In Baths which have helped improve the lives of thousands of people.

Low entry, a built-in seat and temperature control are some of the benefits their baths offer.

Call or send for a **FREE** brochure.

Premier Care
in Bathing

 **GE**
Proudly made
in the USA
Financing by
GE Money
Offer subject to
approval from
GE Money Bank



CALL NOW 1-800-578-2899
TOLL FREE
SOURCE CODE 1216060

Please send me a FREE Premier Care brochure today!

Name _____

Telephone (____) _____

Address _____

City _____

State _____

Zip _____

Send to: Premier Care in Bathing Inc.
2330 South Nova Road, South Daytona, Florida 32119

1216060

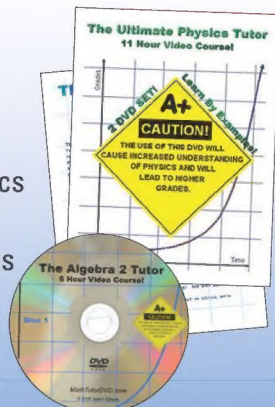
 **MATHTUTORDVD.COM**
Press Play For Success

**Having Math Problems?
WE CAN HELP!**

SUBJECTS:

- Basic Math
- Word Problems
- Pre-Algebra
- Algebra 1 & 2
- Advanced Algebra
- Geometry
- Trig/Pre-Calculus
- Calculus 1, 2, 3
- Physics 1, 2, 3
- Probability & Statistics
- Unit Conversions
- TI Calculator Tutorials

**AVERAGE COURSE
LENGTH: 8 HOURS
MOST COURSES COST
ONLY \$26.99**



Visit
www.MathTutorDVD.com
to watch all courses
online 24/7

**#1 Rated Math &
Physics Tutorial DVDs**

**Our courses are used in public
schools, universities, and libraries!**

**Raise grades or your money back
877-MATH-DVD**

www.MathTutorDVD.com

www.motionmodels.com

**THE WORLDS FINEST READYMADE AND CUSTOM TRUE MUSEUM
QUALITY AIRPLANE AND NAVY AND COAST GUARD SHIP MODELS**



**USS GEORGE H. W. BUSH CVN-77 CUSTOM MADE
FOR NORTHROP GRUMMAN AND PRESIDENT BUSH**

MOST NAVY AND COAST GUARD SHIPS AVAILABLE





www.motionmodels.com
1-800-866-3172

Reviews & Previews

transcends the book's subtitle, though, tracking Curtiss' trailblazing where it leads, through pivotal points in aviation history, naval or not.

Ten years after his death, naval air power helped win World War II. Trimble calls Curtiss "a Lindbergh before Lindbergh." History lauds his contributions, post-Kitty Hawk. Glenn Curtiss probably thought his timing was perfect.

  **STEPHEN JOINER IS A FREQUENT AIR & SPACE/SMITHSONIAN CONTRIBUTOR.**

Credits

It's All Sawdust and Mirrors. After suffering through a year of peace and quiet in Florida, Phil Scott returned to New York City, where he studies the moon with his telescope in Central Park.

A Different Kind of Hybrid. Peter Garrison is a frequent *Air & Space/Smithsonian* contributor.

Titan Air. Tony Reichardt is a senior editor at *Air & Space*.

Truck Killer. A senior researcher at *National Geographic* magazine, David Lande wrote "Live and Let Fly" (Aug./Sept. 2008).

The Real Top Gun. Debbie Gary lives in an airpark near Houston, Texas, where she flies her Super Cub for fun.

Century Series Wannabe. Stephan Wilkinson is an aviation and military history writer, homebuilt-airplane assembler, and Porsche restorer. When he has nothing else to do, he builds model aircraft.

The Last Gunslinger. Based in Boulder, Colorado, Michael Behar writes about aerospace, adventure travel, science, and environmental issues.

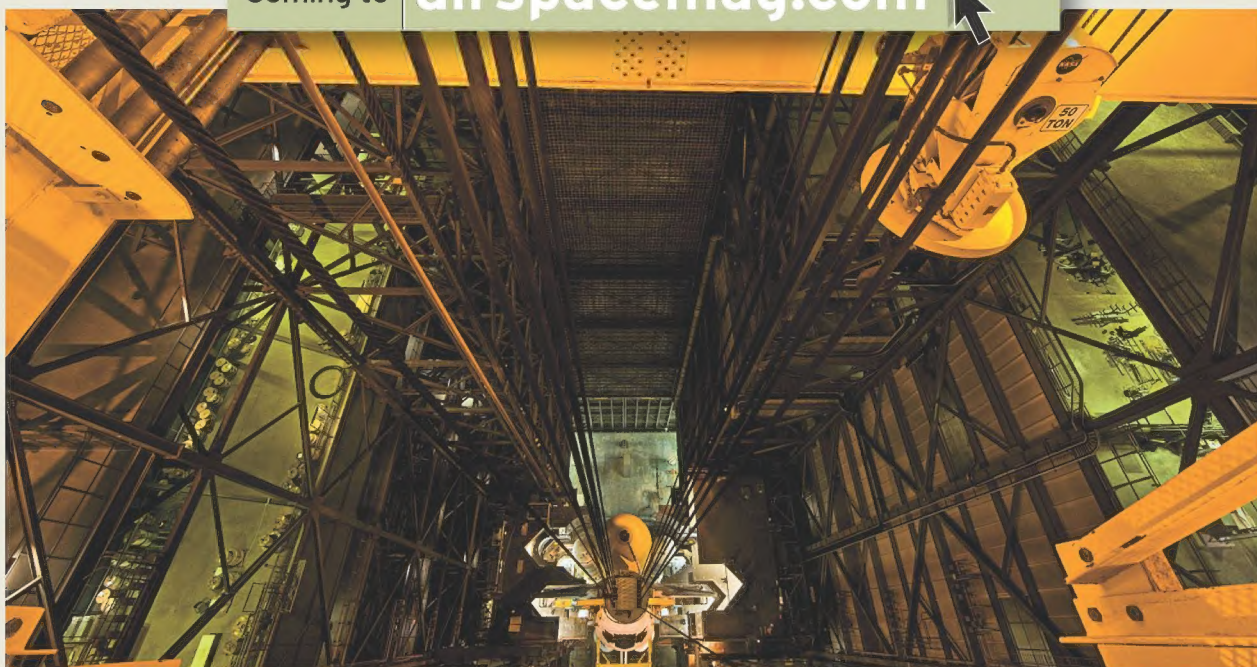
Climate Control. Sam Kean is the author of *The Disappearing Spoon* (Little, Brown, 2010).

Evolution of the Space Shuttle. Michael Klesius is an *Air & Space* associate editor.

Medevac From Luzon. Roger Connor is the curator of the National Air and Space Museum's vertical-flight collection.

Business Models. Roger A. Mola is an *Air & Space* researcher.

Coming to **airspacemag.com**



SCOTT ANDREWS

▲ **Discovery behind closed doors.** An exclusive time-lapse video takes you inside NASA assembly buildings as space shuttle *Discovery* is readied for its next-to-last flight.

Airshow Spotter's Guide. Can't tell a Sabre from a MiG? Download our airshow spotter's guide – or if you're already at a show, call it up on your mobile at airspacemag.com/spotter.

From Beyond: A gallery of planetary photos from Michael Benson's book (and the National Air and Space Museum exhibit) *Beyond: Visions of Our Solar System*.

IN THE NEXT ISSUE

What's My Line?

He wields no power, makes no decisions, and controls no budget. Yet he has helped choose the technologies the Air Force relies on. The job – Air Force Chief Scientist.

Wild About WACOs

Open cockpit or cabin, straight- or taper-wing: after 50 years the civilian biplane still inspires.

My Mother Had Wings

When your mom is a former member of the elite WASP, you learn there were plenty of adventures on the homefront during World War II.

MARKET CONDITIONS



The last time silver hit \$50 an ounce, China was a poor, underdeveloped nation. Now, the Chinese are rich and using three times as much silver! Will this drive the price of silver back to \$50 or even higher? One thing is certain – increased demand and reduced supply have seen silver prices rise to over \$20 per ounce – that's triple in the last four years, and double in the last year alone! As a result, demand for silver coins rose an astounding 63%, but you can get these Morgans for the same price we charged four years ago, just \$19.90 each!

Direct from Locked Vaults to U.S. Citizens!

Original U.S. Gov't Morgan Silver Dollars

National Collector's Mint announces a special limited release of 3,244 Morgan Silver Dollars 89-132 years old at \$19.90 each. Several prominent national dealers charge from \$10 to \$30 MORE for a comparable Morgan Silver Dollar. These Morgans are among the last surviving originals still in existence, and each coin is guaranteed to be in mostly Brilliant Uncirculated to Fine condition. Due to volatile fluctuations in the precious metals market, price can be guaranteed @ \$19.90 each for one week only! Orders will be filled on a first-come, first-served basis and a limit of 100 coins per customer will be strictly adhered to. Timely mail orders will be accepted if directed to: National Collector's Mint, Dept. 7096, 8 Slater St., Port Chester, NY 10573. THIS OFFER MAY BE WITHDRAWN AT ANY TIME WITHOUT NOTICE AT THE SOLE DISCRETION OF NCM.

You may order one Morgan for \$19.90 plus \$4 s, h & ins., 3 for \$66.70 ppd., 5 for \$109 ppd., 10 for \$212 ppd., 20 for \$417 ppd., 50 for \$1025 ppd., 100 for \$2025 ppd. 30-Day Money Back Guarantee.



CALL TOLL-FREE 1-800-799-MINT ASK FOR EXT. 7096

National Collector's Mint, Inc. is an independent, private corporation not affiliated with, endorsed, or licensed by the U.S. government or the U.S. Mint. © 2010 NCM, Inc. AB-A6B

Moments & Milestones

PRODUCED IN COOPERATION WITH THE NATIONAL AERONAUTIC ASSOCIATION



Mile-High Man

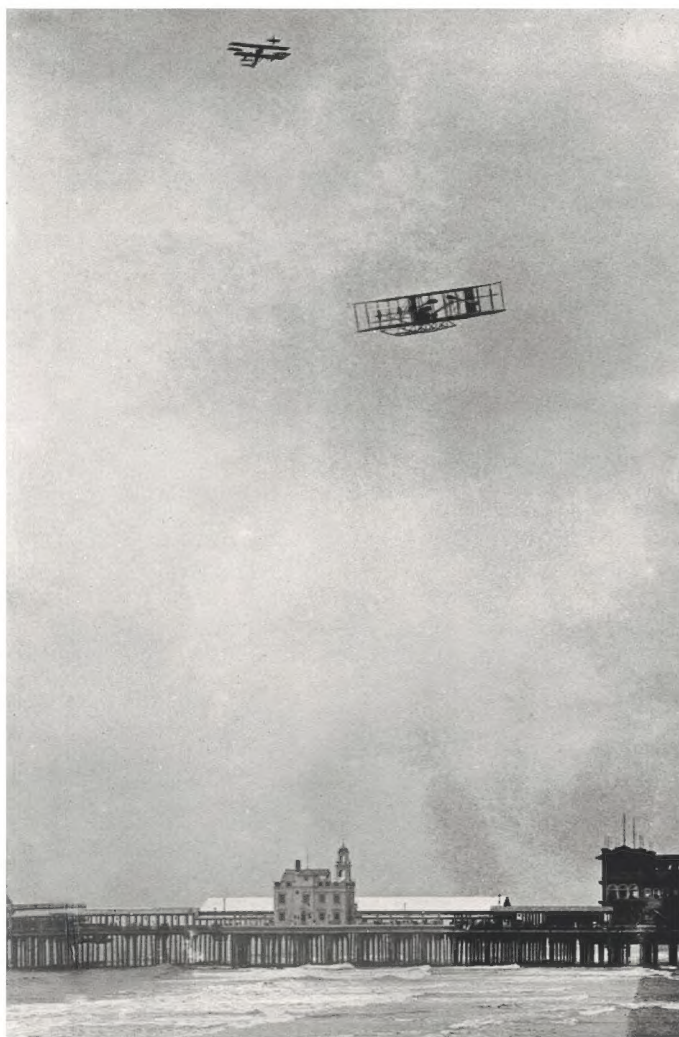
WHEN THE WRIGHT BROTHERS

were first experimenting with powered flight, Walter Brookins was just a teenage kid hanging around their Dayton, Ohio home. He must have ingratiated himself with the family, whom he had known since he was four, because the Wrights, who called him Brooky, promised to build him an airplane one day. He ended up working for the brothers, and even setting a flying record as their employee, but after a quarrelsome split, he left the Wright organization, obscuring his accomplishments.

Brookins was born in Dayton in July 1889. At one time he was a student of Katharine Wright, Orville and Wilbur's sister and an Oberlin College-educated schoolteacher. Orville in particular took a liking to young Brookins and selected him to be the first person he would train to fly. By 1909, six years after the Wrights' first flights, the airplane was attracting crowds at air meets and exhibitions. Katharine and the brothers had deep misgivings about the daredevil nature of exhibition flying, but Orville and Wilbur finally formed a team of fliers in 1910 (see "Ladies and Gentlemen, the Aeroplane!" Apr./May 2008).

According to accounts of the period around 1910, Brookins was the team's most daring and accomplished member. He reportedly flew solo after only two and a half hours of Orville's tutelage, and then trained two other members of the team in Orville's absence.

Photographs of Brookins reveal a clean-shaven, youthful fellow who could be played by Ben Affleck in a high-collar shirt, cravat, and a newsboy cap. One newspaper account describes



As Walter Brookins set an altitude record over the Atlantic City pier, Glenn Curtiss followed in the chase plane.

him as "slight," which would have been to his advantage in one of his more demanding stunts, during which he'd rack the wispy airplane over onto one wingtip in a 90-degree bank and fly a tight circle that would have pulled more than two Gs.

It was in Atlantic City, New Jersey, on July 9, 1910—exactly 100 years ago—that Brookins became the first flier to take an airplane more than a mile up. A mile! (Actually, Brookins went nearly 900 feet higher, but "one mile" made for sensational headlines.) The feat won the Wrights \$5,000, but for Brookins himself, the contract salary was \$20 a week plus \$50 per day of flying; all prize money went to the team.

Possibly disgruntled at the contract pay and at not getting a share of the prize money, Brookins began negotiating for a job with the Pioneer

Aeroplane and Exhibition Company of St. Louis. The Wright brothers, who took to litigation as if they had been born in a courtroom, immediately threatened to seek an injunction to ground him. The threat marked the end of the professional relationship between the Wrights and Brookins, who had read enough newspaper stories about himself to decide to go it alone.

During his solo career, Brookins set one long-distance record after another. An item in the February 6, 1911 *Washington Post* summarizes succinctly the effect of these accomplishments:

His wife, Grace, suing him for divorce, charged him with desertion.

Brookins worked for a time in Milwaukee as a chauffeur for a retired industrialist, and later became a partner in a Hollywood, California company called the Davis-Brookins Aircraft Corporation, which had been formed as the patent holder for the Davis airfoil. That airfoil was famously used on the Consolidated B-24 Liberator bomber of World War II. Brookins died at home in Hollywood in 1953 after a four-month illness and was buried in the Portal of the Folded Wings, a shrine for pilots.

Celebrating the centennial of the first flight to exceed one mile in altitude is an idea that is unlikely to catch on in an era when light airplanes routinely fly at more than 5,000 feet and tourists are reserving seats for rides to the edge of space. But if you're on a quiz show and they ask who was the first man to fly a mile high, remember ol' Walter.

■ ■ ■ GEORGE C. LARSON, MEMBER, NAA

VISIT THE NAA WEB SITE AT WWW.NAA.AERO OR CALL (800) 644-9777.

